Foreword

This soil survey contains information that can be used in land-planning programs in the Camas County Area. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

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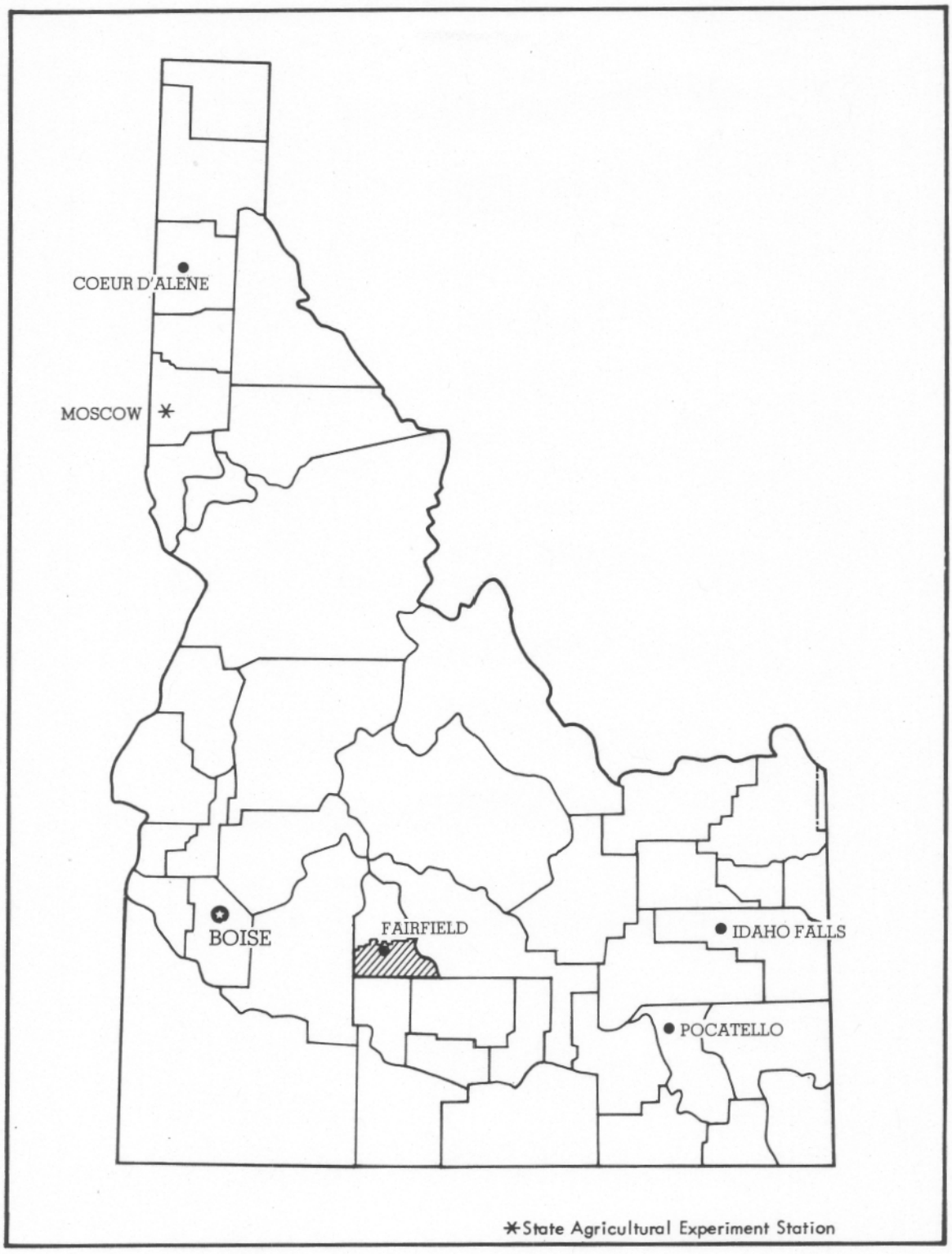

Location of Camas County Area in Idaho.

Soil Survey of

Camas County Area Idaho

United States Department of Agriculture, Soil Conservation Service in cooperation with

United States Department of Agriculture, Science and Education Administration
United States Department of the Interior, Bureau of Land Management
University of Idaho College of Agriculture, Idaho Agricultural Experiment Station

By Charles W. Case, Soil Conservation Service

Fieldwork by Charles W. Case, Gary A. Monroe, Glen H. Logan, and Darrell L. Gallup, Soil Conservation Service

CAMAS COUNTY AREA is in south-central Idaho. It is bounded on the east by Blaine County, on the south by Gooding and Lincoln Counties, on the west by Elmore County, and on the north by the Sawtooth National Forest. It covers an area of 343,980 acres, or about 537 square miles.

The elevation ranges from 4,750 feet, near Magic Reservoir, to about 8,200 feet, at Cannonball Mountain. Fairfield is at an elevation of 5,059 feet; and Hill City, 5,092 feet. Davis Mountain has an elevation of 6,806 feet.

The middle one-third of the survey area is a broad, alluvial valley that is 3 to 11 miles wide and about 28 miles long. Most of the soils in this valley are cultivated. Camas Creek and its tributaries dissect the valley. The southern one-third of the area consists of rolling uplands and the steep Mount Bennett Hills. The northern one-third of the area consists of mountains and narrow, alluvial valleys.

General nature of the survey area

This section gives general information about the survey area. It discusses settlement; transportation; farming; natural resources; physiography, relief, and drainage; and climate.

Settlement

Camas Prairie was explored by Donald MacKenzie in 1820, and it was settled around, 1880.

In 1881, the first land claims were filed under provisions of the Desert Land Act of 1877. Under that act, irrigable desert land could be bought for 1 dollar and 25 cents per acre if the purchaser could demonstrate that he was able to irrigate and cultivate the land.

Idaho became a state in 1890. The railroad was completed in 1914. Camas County, originally a part of Alturas County and then Blaine County, was organized in 1917. The population was 1,804 in 1910 and 728 in 1970.

Fairfield, the county seat, was established in 1911. It is the largest town; the population was 336 in 1970.

Agriculture is the major contributor to the economy. There is a lumber mill at Fairfield. The survey area is experiencing some economic growth as a result of recreation development-for example, the construction of summer homes. A ski area in the Soldier Mountains attracts winter visitors.

Transportation

The Camas County Area is served by a branch of the Union Pacific Railroad, which terminates at Hill City.

State Highway 46 connects Fairfield and Gooding, and State Highway 68 crosses the survey area from east to west. A farm-to-market road, north of Fairfield, leads to the Soldier Mountain Ski Area.

Fairfield has an airport that is used mainly by private planes. There is a small, private airstrip at Hill City.

Farming

The first crops grown on the Camas Prairie-wheat and potatoes-were grown without irrigation. The farmers thought that irrigation would keep wheat from maturing before the first killing frost in fall.

An alfalfa hay-grain-livestock system dominates agriculture in the survey area. Alfalfa hay is the principal crop. Spring wheat and barley are also important.

About 15,000 acres of cropland is irrigated. Of this, about 9,700 acres is irrigated with water from Twin Lakes Reservoir. Water from reservoirs and creeks is plentiful in spring and early in summer, but, in most years, supplies are short late in summer. Bottom lands are flooded in spring, and the soils in these areas have a high water table throughout most of the summer.

Most of the livestock operations are either beef cattle or sheep. A few farmers raise dairy cattle. Many ranchers move their livestock to lower elevations, mainly in Gooding County, for the long, snowy winter.

Natural resources

Soil and water are the most important natural resources in the survey area.

In most years there is adequate moisture from snow and rain to produce a crop without irrigation. Water for irrigation is provided by creeks, wells, and reservoirs.

Twin Lakes Reservoir is the main reservoir in the survey area. It has a storage capacity of 33,000 acre-feet, but has filled only 3 times in 40 years. The upper end of Magic Reservoir lies in the extreme southeastern part of the area. Several smaller reservoirs serve the Camas County area.

Physiography, relief, and drainage

The survey area lies within two geological provinces. The southern part of the area is in the Columbia Plateau Province, and the northern part is in the Rocky Mountain Province.

Relief and geology are extremely varied. The southern part of the survey area consists of rolling to steep uplands and hills that are composed of rhyolitic and silicic volcanics. The east-central part is an undulating lava plain. The west-central part consists of smoothly sloping alluvial fans, terraces, and bottom lands. The northern part consists of steep mountains that are composed of granite and andesite.

Camas Creek drains most of the survey area. Twelve tributaries of Camas Creek drain the northern mountains, and two tributaries drain the southern hills. Camas Creek empties into Magic Reservoir.

Climate

The Rocky Mountains partly shield the survey area from strong Arctic winds, so winters are generally not too severe. In summer, Pacific Ocean winds are partly blocked; days are hot, but nights are fairly cool. Precipitation is scant in summer, except in mountainous areas. It is adequate for nonirrigated small grains or rangeland during the cooler parts of the year in many places. The snowpack at high elevations supplies irrigation water for intensive agriculture in parts of the lowland.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Hill City, Idaho, in the period 1951 to 1973. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 20 degrees F, and the average daily minimum is 9 degrees. The lowest temperature on record, -42 degrees, occurred at Hill City on January 22, 1962. In summer the average temperature is 63 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred on July 23, 1959, is 101 degrees.

Growing degree days, shown in Table 1, are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 5 inches, or 31 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 4 inches. The heaviest 1-day rainfall during the period of record was 2.02 inches at Hill City on February 20, 1952. There are about 15 thunderstorms each year, 8 of which occur in summer.

Average seasonal snowfall is 93 inches. The greatest snow depth at any one time during the period of record was 68 inches. On the average, 31 days have at least 1 inch of snow on the ground, but the number of days varies greatly from year to year.

The average relative humidity in midafternoon in spring is less than 40 percent; during the rest of the year it is about 45 percent. Humidity is higher at night, and the average at dawn is about 65 percent. The percentage of possible sunshine is 85 in summer and 45 in winter. The prevailing wind is from the southeast. Average windspeed is highest, 10 miles per hour, in March.

How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that

help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

General soil map for broad land use planning

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in the survey area vary widely in their potential for major land uses. Table 4 shows the extent of the map units shown on the general soil map. It lists the potential of each, in relation to that of the other map units, for major land uses and shows soil properties that limit use. Soil potential ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used.

Each map unit is rated for *irrigated crops, dryfarmed crops, range, intensive recreation areas, and extensive recreation areas.* Irrigated crops are those grown extensively with irrigation in the survey area. Dryfarmed crops are those grown extensively without irrigation. Range refers to land that produces vegetation suitable for grazing by livestock. Intensive recreation areas are campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic. Extensive recreation areas are those used for nature study and as wilderness.

Descriptions of map units

1. Roanhide-Earcree

Moderately deep to very deep, gently sloping to steep, well drained soils that formed in material derived from granite; on hills and mountains

This map unit is in the northwestern, northeastern, and southwestern parts of the survey area. The slope ranges from 4 to 60 percent (fig. 1). Elevation ranges from 5,200 to 7,500 feet. The average annual precipitation is 12 to 22 inches, the average annual temperature is 37 to 43 degrees F, and the frost-free period is 60 to 100 days.

This map unit makes up about 17 percent of the survey area. Roanhide soils make up about 50 percent of the map unit, and Earcree soils make up 25 percent. Minor soils and Rock outcrop make up the rest.

Roanhide soils are on south- and west-facing side slopes. These soils are moderately deep and well drained. The surface layer is grayish brown coarse sandy loam. The subsoil is brown coarse sandy loam. The substratum is light brownish gray coarse sandy loam. It is underlain by granite bedrock at a depth of 20 to 40 inches.

Earcree soils are on north- and east-facing side slopes. These soils are deep and very deep and well drained. The surface layer is dark grayish brown gravelly coarse sandy loam. The underlying material is light brownish gray gravelly loamy coarse sand. Bedrock is at a depth of 50 inches or more.

The minor soils in this map unit are well drained, very deep Bauscher loam on alluvial fans; well drained, deep Lockman stony sandy loam on north-facing side slopes; and poorly drained, very deep Marshdale loam on bottom lands.

The soils in this map unit are used mainly for range. They support summer range for mule deer. Springs can be developed or ponds can be built on the bottom lands to provide water for livestock. The included Bauscher soil is dryfarmed in some small areas. The included Lockman soil is used for timber.

The use of these soils for building site development and for sanitary facilities is limited mainly by slope.

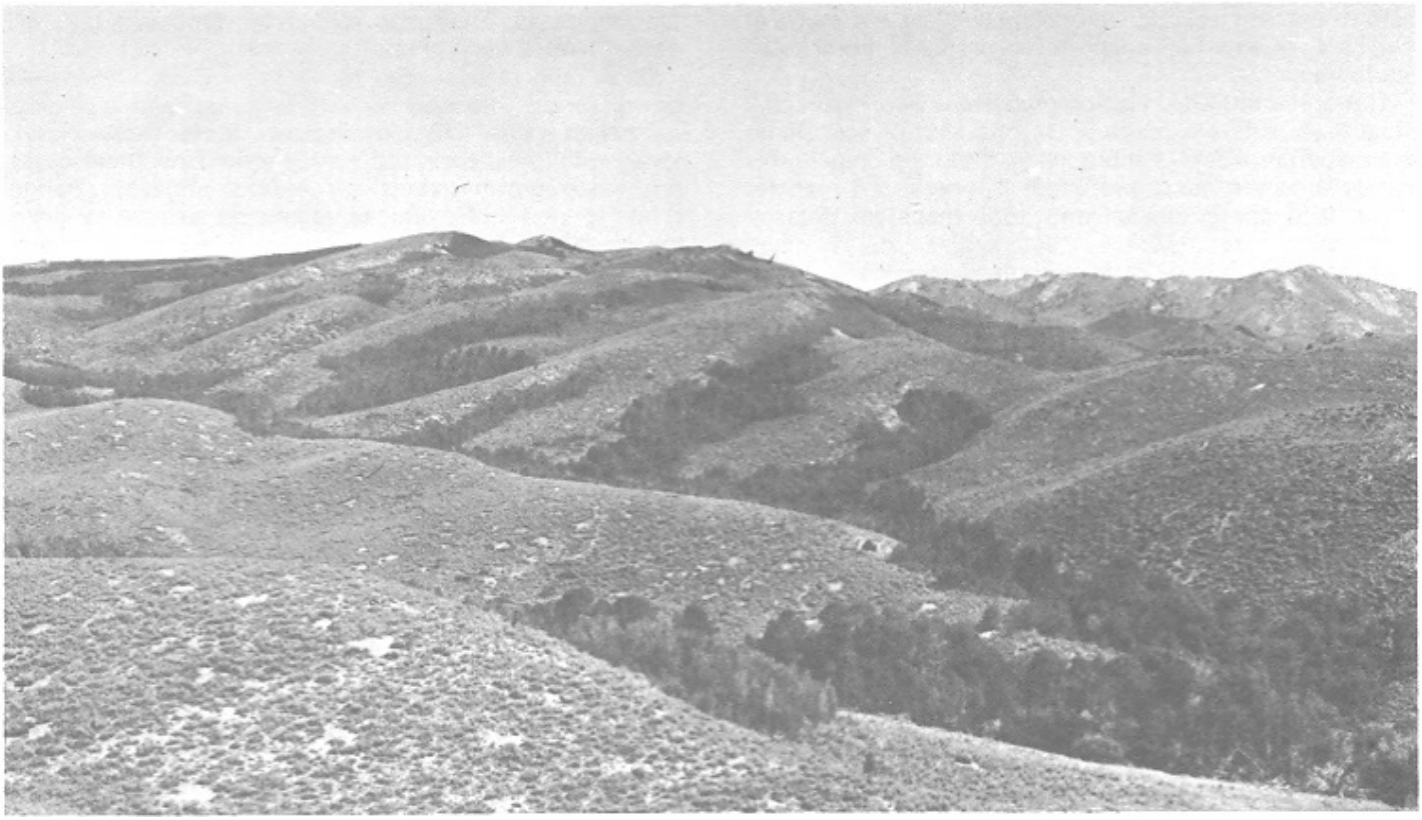

Figure 1.-An area of the Roanhide-Earcree map unit on the general soil map.

2. Gaib-Rock outcrop-Earcree

Shallow to very deep, moderately sloping to steep, well drained soils that formed in material derived from andesite and rhyolite, and Rock outcrop,' on uplands

This map unit is in the northern part of the survey area, between Soldier Creek and Willow Creek. The slope ranges from 4 to 60 percent. Elevation ranges from 5,400 to 8,200 feet. The average annual precipitation is 12 to 22 inches, the average annual temperature is 36 to 45 degrees F, and the frost-free season is 60 to 100 days.

This map unit makes up about 6 percent of the survey area. Gaib soils make up about 25 percent of this map unit; Rock outcrop, 20 percent; and Earcree soils, 15 percent. Minor soils make up the rest.

Gaib soils are on south- and west-facing side slopes. These soils are shallow and well drained. The surface layer is grayish brown very gravelly loam. The subsoil is brown very cobbly sandy clay loam and very stony clay loam. It is underlain by bedrock at a depth of 10 to 20 inches.

Rock outcrop consists of exposed andesite bedrock. In some places, very shallow soil material covers the bedrock. This soil material supports little or no vegetation.

Earcree soils are on north- and east-facing side slopes. These soils are deep and very deep and well drained. The surface layer is dark grayish brown gravelly coarse sandy loam. The underlying material is light brownish gray gravelly loamy coarse sand.

The minor soils in this map unit are well drained, deep Lockman stony sandy loam on north-facing side slopes; well drained, moderately deep Roanhide coarse sandy loam on south-facing side slopes; well drained, moderately deep Elkcreek loam on south-facing side slopes; and well drained, very deep Simonton loam on alluvial fans.

The soils in this map unit are used mainly for range, and they support habitat for mule deer. Springs can be developed or ponds can be built in stream channels to provide water for livestock. The included Elkcreek soil and Simonton soil, in some small areas, are dryfarmed. The included Lockman soil is used for timber.

Slope and depth to bedrock are the main limitations to use of the soils for building site development and for sanitary facilities.

3. Gaib-Elkcreek

Shallow and moderately deep, nearly level to steep, well drained soils that formed in material derived from andesite, basalt, and rhyolite; on uplands

This map unit is in the southern part of the survey area. It includes the Mount Bennett Hills. The slope ranges from 0 to 60 percent. Elevation ranges from 5,000 feet to 6,800 feet. The average annual precipitation is 12 to 16 inches, the average annual temperature is 40 to 45 degrees F, and the frost-free period is 70 to 100 days.

This map unit makes up about 24 percent of the survey area. Gaib soils make up about 30 percent of this map unit, and Elkcreek soils make up 20 percent. Minor soils and Rock outcrop make up the rest.

Gaib soils are on steep, west- and south-facing side slopes. These soils are shallow and well drained. The surface layer is grayish brown very gravelly loam. The subsoil is brown very cobbly sandy clay loam and brown very stony clay loam. It is underlain by rhyolite bedrock at a depth of 10 to 20 inches.

Elkcreek soils are on rolling, south-facing side slopes. These soils are moderately deep and well drained. The surface layer is dark grayish brown loam. The subsoil is brown and pale brown clay loam. It is underlain by rhyolite bedrock at a depth of 26 to 40 inches.

The minor soils are well drained, moderately deep Winu stony loam on steep, north-facing side slopes; well drained, shallow Polecreek very gravelly loam on south-facing side slopes; well drained, very deep Rands loam and Simonton loam on alluvial fans; well drained, moderately deep Manard very stony silt loam in small areas underlain by basalt; and somewhat poorly drained, very deep Houk silty clay loam on bottom lands.

The soils in this map unit are used entirely for range, and numerous springs have been developed to provide water for livestock. These soils support habitat for mule deer and elk throughout the year.

Slope and depth to bedrock are the main limitations to the use of the soils for building site development and for sanitary facilities.

4. Manard-Magic

Moderately deep, nearly level to gently sloping, well drained soils that formed in material derived from basalt; on lava plains

This map unit is mainly in the eastern and central parts of the survey area, between Camas Creek and the Mount Bennett Hills. The slope ranges from 0 to 8 percent. Elevation ranges from 4,800 to 6,000 feet. The average annual precipitation is 12 to 16 inches, the average annual temperature is 39 to 43 degrees F, and the frost-free period is about 70 to 100 days.

This map unit makes up about 16 percent of the survey area. Manard soils make up about 40 percent of this map unit. Magic soils make up 15 percent. Minor soils and Rock outcrop make up the rest.

Manard soils are gently sloping; they are on lava plains. These soils are moderately deep and well drained. The surface layer is grayish brown very stony silt loam. The subsoil is pale brown silty clay loam and light yellowish brown silty clay. The substratum is an indurated hardpan. It is underlain by basalt bedrock at a depth of 20 to 38 inches.

Magic soils are nearly level to gently sloping; they are in concave areas on lava plains. These soils are moderately deep and well drained. The surface layer is brown very stony silty clay. The subsoil is brown and pinkish gray silty clay. It is underlain by basalt bedrock at a depth of 25 to 40 inches.

The minor soils are well drained, very deep Kevanton sandy loam; well drained, moderately deep Harahill loam; well drained, very deep Laurentzen loam; well drained, shallow Gaib very gravelly loam and Polecreek very gravelly loam; and somewhat poorly drained, very deep Houk silty clay loam.

The soils in this map unit are used mainly for range. Springs have been developed to provide water for livestock. These soils also support habitat for sage grouse. In small areas the Manard and Magic soils are used as irrigated and dryfarmed cropland. In small areas the included Harahill and Laurentzen soils are suitable for use as cropland.

Depth to bedrock and clayey texture are the main limitations to the use of the soils for building site development and for sanitary facilities.

5. Simonton-Brinegar

Very deep, nearly level to strongly sloping, well drained and moderately well drained soils that formed in alluvium, on fans and terraces

This map unit is in the northern part of the survey area, between Camas Creek and the Soldier Mountains. The slope ranges from 0 to 12 percent. Elevation ranges from 4,800 to 5,400 feet. The average annual precipitation is 12 to 16 inches, the average annual temperature is 39 to 43 degrees F, and the frost-free period is 70 to 100 days. Numerous streams cut through the landscape, north to south, from the Soldier Mountains to Camas Creek.

This map unit makes up about 25 percent of the survey area. Simonton soils make up about 55 percent of the map unit. Brinegar soils make up 30 percent. Minor soils make up the rest.

Simonton soils are well drained and nearly level to strongly sloping. The surface layer is grayish brown loam, the subsoil is pinkish gray and light brown loam, and the substratum is light gray loamy sand.

Brinegar soils are moderately well drained and nearly level to gently sloping. The surface layer is dark gray loam, the subsoil is pale brown sandy clay loam and clay loam, and the substratum is light brown coarse sandy loam and gravelly coarse sand.

The minor soils in this map unit are well drained, very deep Rands loam on terraces; well drained, very deep

Riceton coarse sandy loam on alluvial fans; well drained, very deep Little Wood very gravelly loam; somewhat excessively drained, very deep Vodermaier gravelly coarse sandy loam; and poorly drained, very deep Marshdale loam.

The soils in this map unit are used mainly as dryfarmed cropland (fig. 2), but an increasing acreage is being used as irrigated cropland. In small areas, the soils are used for range. Sage grouse use the cultivated areas for feeding and the range areas for nesting.

The shrink-swell potential, frost action potential, and, on Brinegar soils, rare flooding are the major limitations to the use of the soils for building site development and for sanitary facilities.

6. Marshdale-Strom-Honk

Very deep, nearly level to gently sloping, poorly drained and somewhat poorly drained soils that formed in alluvium; on fans, low terraces, and bottom lands

This map unit is on Camas Creek and its tributaries. It extends from Deer Creek to the Elmore County line. The slope ranges from 0 to 4 percent (fig. 3). Elevation ranges from 5,000 to 5,500 feet. The average annual precipitation is 12 to 16 inches, the average annual temperature is 39 to 45 degrees F, and the frost-free period is 70 to 100 days.

This map unit makes up about 11 percent of the survey area. Marshdale soils make up about 40 percent of the map unit; Strom soils, 30 percent; and Houk soils, 20 percent. Minor soils make up the rest.

Marshdale soils are nearly level to gently sloping, and they are poorly drained. The surface layer is dark gray loam, and the underlying material is light gray clay loam and loamy coarse sand.

Strom soils are nearly level to gently sloping, and they are somewhat poorly drained. The surface layer is dark gray loam or sandy clay loam, the subsoil is dark gray clay loam and gray loam, and the substratum is light gray sandy loam.

Houk soils are nearly level, and they are somewhat poorly drained. The surface and subsurface layers are gray silty clay loam, the subsoil is dark gray clay and

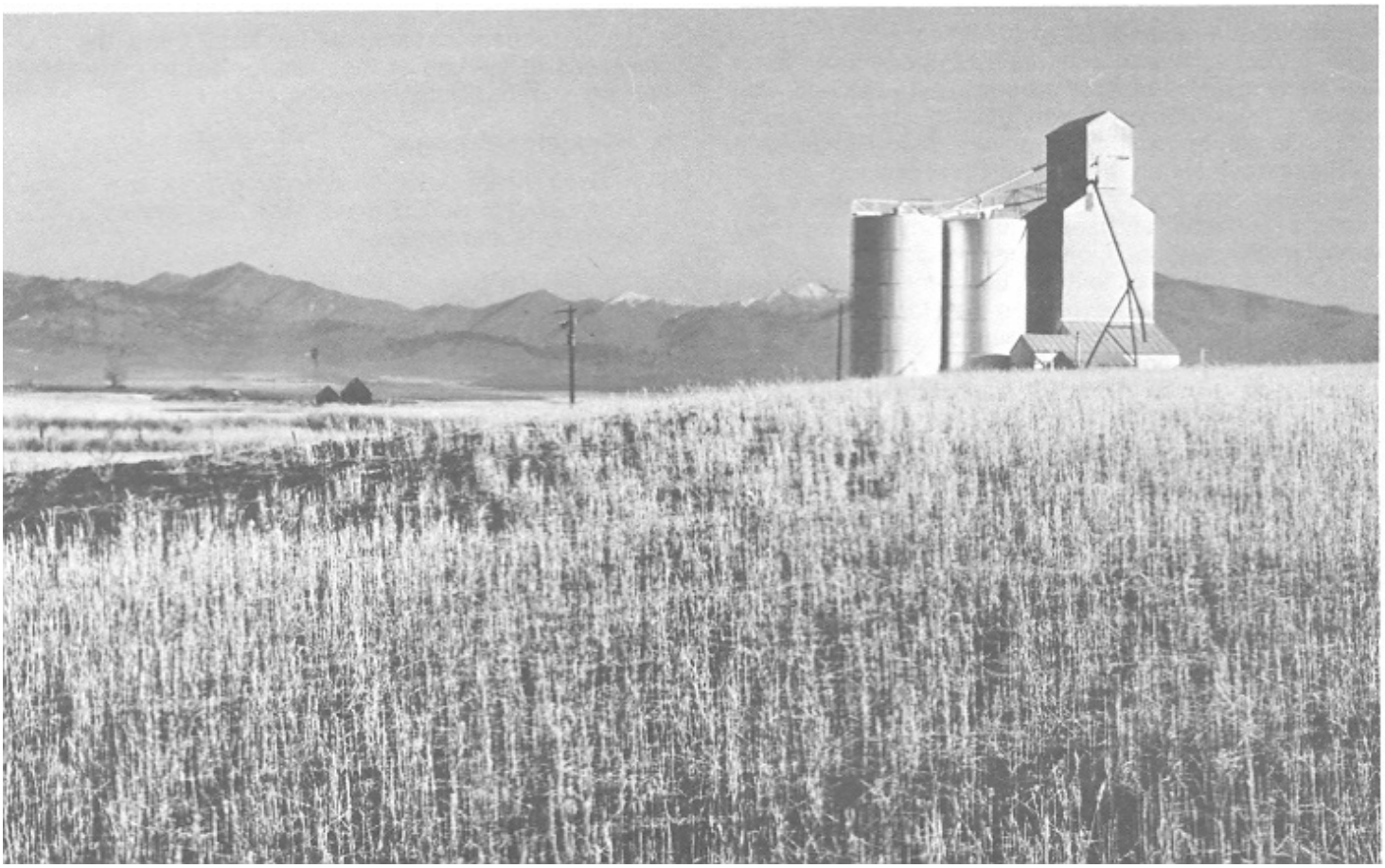

Figure 2.-The dryland alfalfa hay in the foreground is on Brinegar loam, 0 to 1 percent slopes.

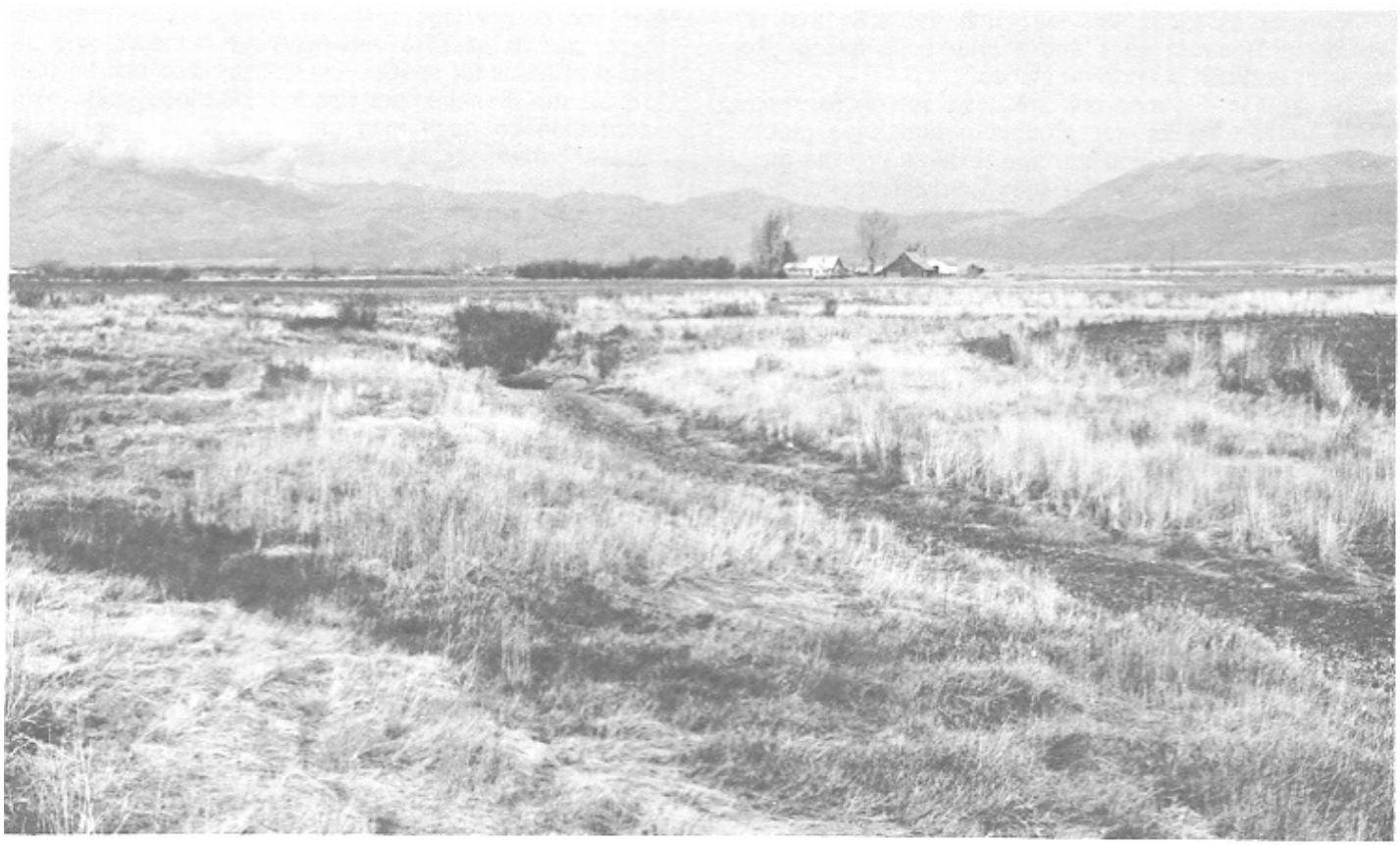

Figure 3.-An area of the Marshdale-Strom-Houk map unit on the general soil map.

gray clay loam, and the substratum is light gray sandy loam.

The minor soils in this map unit are very deep, somewhat poorly drained Brailsford loam and Brailsford Variant loam and very deep, moderately well drained Brinegar loam.

The soils in this map unit are used mainly as dryfarmed cropland. In some small areas, they are used as irrigated cropland or pasture. These soils support habitat for mule deer and waterfowl.

Flooding, wetness, and low strength are the major limitations to the use of these soils for building site development and for sanitary facilities.

7. Bostrum-Yutrue

Moderately deep and very deep, nearly level to strongly sloping, well drained soils that formed in material derived from basalt, on lava plains

This map unit is in the southeastern part of the survey area, along the boundary that separates Blaine County and Camas County. The slope ranges from 0 to 20 percent. Elevation ranges from 4,750 to 5,000 feet. The average annual precipitation is 12 to 16 inches, the average annual temperature is 45 to 50 degrees F, and the frost-free period is 70 to 100 days.

This map unit makes up about 1 percent of the survey area. Bostrum soils make up about 75 percent of the map unit, and Yutrue soils make up 15 percent. Minor soils and Rock outcrop make up the rest.

Bostrum soils are moderately deep and nearly level to strongly sloping. They are on convex parts of the lava plain. The surface layer is light brownish gray gravelly silt loam, and the subsurface layer is light gray silt loam. The subsoil is brown silty clay and light yellowish brown silty clay loam. It is underlain by bedrock at a depth of 20 to 40 inches.

Yutrue soils are very deep and nearly level to strongly sloping. They are on concave parts of the lava .plain. The surface layer is light brownish gray stony clay in the upper part and light brownish gray clay in the lower part. The subsoil is pale brown silty clay loam and silt loam.

Of minor extent in this map unit are soils that are similar to Bostrum soils and Yutrue soils except that depth to bedrock is 20 to 40 inches.

The soils in this map unit are used entirely for range. They support habitat for pronghorn and sage grouse.

Depth to bedrock and the fine textures are the major limitations to the use of the soils for building site development and for sanitary facilities.

Broad land use considerations

Approximately 36 percent of the survey area is used for cultivated crops, mainly alfalfa hay, spring wheat, and barley. This cropland is concentrated in map units 5 and 6 on Camas Prairie. The soils in map unit 6 are flooded by snowmelt early in spring in most years. Wetness is the major limitation for crops. Most of the cropland in map unit 6 is on Marshdale, Strom, and Houk soils. The soils in map unit 5 are on alluvial fans and terraces. On these soils, erosion and the short growing season are the main limitations for cultivated crops. Most of the cropland in map unit 5 is on Simonton, Brinegar, and Rands soils.

Approximately 63 percent of the survey area-map units 1, 2, 3, 4, and 7-is rangeland. The major soils in these map units are Elkcreek, Gaib, Earcree, and Roanhide soils on hills and Manard, Magic, Harahill, and Kevanton soils on lava plains. The major limitations to seeding are the steep slopes of the soils in map units 1, 2, and 3 and surface stones or the shallowness to a clay layer or bedrock of the soils in map units 3, 4, and 7.

The potential for recreation ranges from poor to good, depending on the intensity of the expected use. The soils in map unit 5 have good potential for intensive recreation development. The soils in map units 4 and 7 have moderate potential because of stoniness. The soils in units 1, 2, and 3 have poor potential because of steep slopes, and the soils in unit 6 have poor potential because they are subject to flooding. The soils in all of these units are suitable for such uses as hiking, horseback riding, and snowmobiling. Within the map units of soils that have poor potential there are small areas where the soils are suitable for intensive recreation development.

The potential for wildlife habitat is fair to good throughout the survey area. The soils in map units 5 and 6 have fair potential for habitat for openland wildlife. The Lockman soil in map units 1 and 2 has good potential for habitat for woodland wildlife. The soils in map unit 6 have fair potential for habitat for wetland wildlife. The soils in map units 1, 2, 3, 4, 5, and 7 have good potential for habitat for rangeland wildlife.

Soil maps for detailed planning

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

Soils that have profiles that are almost alike make up *a soil series.* Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Simonton loam, 0 to 4 percent slopes, is one of several phases in the Simonton series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A soil complex consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Elkcreek-Gaib complex, 0 to 30 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 5 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil descriptions

1-Bauscher loam, 0 to 12 percent slopes. This is a very deep, well drained soil that formed in material that weathered from granite. It is on alluvial fans and hills. The elevation ranges from 5,100 to 6,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is grayish brown loam about 14 inches thick. The subsoil is brown and pale brown loam and light yellowish brown coarse sandy loam 35 inches thick. The substratum is pale brown coarse sandy loam.

Included in mapping are small areas of Riceton coarse sandy loam, Simonton loam, and a soil that is similar to this Bauscher soil but is 40 to 60 inches deep to bedrock.

Permeability is moderately slow. The root zone extends to a depth of 60 inches or more. The available water capacity is high. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate.

About 60 percent of the acreage of this soil is used for dryfarmed alfalfa hay and small grains. The rest is used as rangeland and pasture.

In most years there is sufficient moisture for annual cropping. Alfalfa is grown for 10 to 15 years, and spring wheat or barley is grown for 4 or 5 years. Some of the grain is grown as a crop-fallow system to control weeds. Stubble mulching, chiseling, weed control, and minimum tillage help to control erosion and produce favorable crop growth. Chiseling breaks up the plowpan and thereby promotes better root penetration and improves aeration. If done on the contour or across the slope, chiseling also reduces runoff. Smooth bromegrass and intermediate wheatgrass are suitable grasses for seeding pasture and waterways.

The native vegetation on this soil is mainly bluebunch wheatgrass and Idaho fescue. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice, and it can be done late in fall or early in spring.

This soil provides habitat for ground squirrel, mourning dove, western meadowlark, cottontail rabbit, snowshoe rabbit, hawk, falcon, and sage grouse. It provides habitat for mule deer late in fall, in winter, and early in spring.

The shrink-swell potential is the main limitation to the use of this soil as sites for buildings.

This map unit is in capability subclass IIIe, nonirrigated.

2-Bauscher loam, 12 to 25 percent slopes. This is a very deep, well drained soil that formed in material that weathered from granite. It is on alluvial fans and hills. The elevation ranges from 5,100 to 6,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is grayish brown loam 14 inches thick. The subsoil is brown and pale brown loam and light yellowish brown coarse sandy loam 35 inches thick. The substratum is pale brown coarse sandy loam.

Included in mapping are small areas of Earcree gravelly coarse sandy loam, Roanhide coarse sandy loam, and a soil that is similar to this Bauscher soil but is 40 to 60 inches deep to granite.

Permeability is moderately slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is rapid, and the hazard of erosion is moderate to high.

About 25 percent of the acreage of this soil is used for dryfarmed alfalfa hay and small grains. The rest is used as rangeland and pasture.

In most years there is sufficient moisture for annual cropping. Alfalfa is grown for 10 to 15 years, and spring wheat or barley is grown for 4 to 5 years. Some of the grain is grown in a crop-fallow system to control weeds. Stubble mulching, chiseling, weed control, and minimum tillage help to control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan and thereby promotes better root penetration and improves aeration. If done on the contour or across the slope, chiseling also reduces runoff.

The native vegetation on this soil is mainly bluebunch wheatgrass and Idaho fescue. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice, and it can be done late in fall or early in spring.

This soil is well suited to use as habitat for ground squirrel, mourning dove, western meadowlark, cottontail rabbit, snowshoe rabbit, hawk, falcon, and sage grouse. It supports habitat for mule deer late in fall, in winter, and early in spring.

Slope is the main limitation to the use of this soil as sites for buildings.

This map unit is in capability subclass IVe, nonirrigated.

3-Bostrum gravelly silt loam, 0 to 20 percent slopes. This is a moderately deep and well drained soil that formed in material that weathered from basalt. It is on lava plains. The elevation ranges from 4,750 to 5,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 47 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is light brownish gray gravelly silt loam about 5 inches thick. The subsurface layer is light gray silt loam about 3 inches thick. The subsoil in the upper part is brown silty clay about 11 inches thick. In the lower part it is light yellowish brown silty clay loam about 10 inches thick. It is underlain by bedrock.

Included in mapping are small areas of Yutrue stony clay and a soil that is like Bostrum soils except that it is more than 40 inches deep to bedrock. Also included are

areas of a soil that is like Bostrum soils except that it has a surface layer thicker than 9 inches and areas of Rock outcrop.

Permeability is very slow. The root zone extends to a depth of 20 to 40 inches. The available water capacity is high. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

This soil is used for range, and it is suited to habitat for elk, mule deer, pronghorn, sage grouse, rabbit, rockchuck, coyote, hawk, and eagle. The native vegetation is mainly Idaho fescue and low sagebrush. Big sagebrush grows where the surface layer is more than 9 inches thick. If the range deteriorates, the proportion of Idaho fescue decreases, the proportion of forbs and low sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding by conventional methods is generally not a suitable practice because of the gravel in the surface layer and the shallow depth to the fine textured subsurface layer.

Low strength and the shrink-swell potential are the main limitations to the use of this soil as sites for buildings.

This map unit is in capability subclass lVe, nonirrigated.

4-Bostrum-Yutrue complex, 0 to 20 percent slopes. This complex is on lava plains. The elevation ranges from 4,750 to 5,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 47 degrees F, and the frost-free period is about 80 days.

The Bostrum soil makes up about 50 percent of the complex, and the Yutrue soil makes up about 30 percent. The remaining 20 percent includes a soil that is like the Bostrum soil except that it is more than 40 inches deep to bedrock, a soil that is like the Bostrum soil except that it has a surface layer that is more than 9 inches thick, a soil that is like the Yutrue soil except that bedrock is at a depth of 20 to 40 inches, and areas of Rock outcrop. It was not practical to map the soils separately at the scale used.

The Bostrum soil has complex slopes and is on ridgetops and side slopes. It is moderately deep and well drained. It formed in residuum of basalt. Typically, the surface layer is light brownish gray gravelly silt loam about 5 inches thick. The subsurface layer is light gray silt loam about 3 inches thick. The subsoil in the upper part is brown silty clay about 11 inches thick. In the lower part it is light yellowish brown silty clay loam about 10 inches thick. It is underlain by bedrock.

Permeability of the Bostrum soil is very slow. The root zone extends to a depth of 20 to 40 inches. The available water capacity is high. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

The Yutrue soil has concave slopes and is in drainageways. It is deep and very deep and well drained. It formed in material that derived from basalt. Typically, the surface layer in the upper part is light brownish gray stony clay about 2 inches thick. In the lower part it is light brownish gray clay about 24 inches thick. The subsoil is pale brown silty clay loam and silt loam to a depth of 60 inches or more.

Permeability of the Yutrue soil is very slow. The root zone extends to a depth of 40 to 60 inches or more. The available water capacity is very high. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate.

These soils are used for range, and they provide habitat for elk, pronghorn, mule deer, rabbit, sage grouse, rockchuck, coyote, hawk, and eagle. The native vegetation is mainly narrowleaf pussytoes, Idaho fescue, and low sagebrush. Big sagebrush grows in some areas. If the range deteriorates, the proportion of Idaho fescue decreases, the proportion of forbs and low sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding by conventional methods is not usually practical because of the stoniness and the shallow depth to the heavy clay layer.

Low strength and the shrink-swell potential are the main limitations to the use of the soils in this complex as sites for buildings.

This complex is in capability subclass lVe, nonirrigated.

5-Brailsford loam. This is a very deep, somewhat poorly drained soil that formed in mixed alluvium. Areas are in basins, which are about 30 to 50 feet across, on stream terraces and alluvial fans. The elevation ranges from 5,000 to 6,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is gray loam about 8 inches thick. The subsurface layer is gray loam about 4 inches thick. The subsoil in the upper 4 inches is pale brown sandy clay loam; and in the lower 23 inches it is light brownish gray sandy clay loam. The substratum in the upper 6 inches is light brownish gray fine gravelly sandy clay loam; below that, to a depth of 60 inches or more, it is light gray sand.

Included in mapping are small areas of Brinegar loam, Simonton loam, and Strom loam.

Permeability is slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is ponded, and there is no hazard of erosion. The water table is at a depth of 30 to 40 inches, especially in spring.

About 70 percent of the acreage is cultivated cropland. The rest is rangeland. This soil is cultivated in the same way as the surrounding soils, but yields are very low.

The high water table in spring and early summer, frequent flooding, and a short growing season limit the potential of this soil for use as cropland.

While ponded, this soil provides habitat for shore birds and duck.

The high water table and frequent flooding are the main limitations to the use of this soil as sites for houses.

This map unit is in capability subclass VIw, nonirrigated.

6-Brailsford Variant loam. This is a very deep, somewhat poorly drained, strongly saline-alkali soil that formed in mixed alluvium. It is in basins, which are about 10 to 50 feet across, on low stream terraces. The elevation ranges from 5,000 to 5,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is light brownish gray loam about 3 inches thick. The subsoil is pale brown and very pale brown clay loam 18 inches thick. The substratum in the upper part is white, moderately calcareous clay loam 17 inches thick. In the lower part it is stratified to a depth of 60 inches; the upper layer is very pale brown fine gravelly clay loam and fine gravelly loam 11 inches thick; the middle layer is a manganese oxide pan 1 inch thick; and the lower layer is gray, mottled sandy clay loam 10 inches thick.

Included in mapping are small areas of Houk silty clay loam and Strom loam.

Permeability is slow. The root zone extends to a depth of 40 to 60 inches or more. The available water capacity is very high. Surface runoff is ponded, and the hazard of erosion is none to slight. The water table is at a depth of 3 to 5 feet in spring.

About 80 percent of the acreage of this soil is dryfarmed cropland, but yields are very low. The rest is rangeland.

The high water table in spring and early summer, frequent flooding, and a short growing season limit the potential of this soil for use as cropland.

While ponded, this soil is suited to habitat for shore birds and duck.

The high water table and frequent flooding are the main limitations to the use of this soil as sites for houses.

This map unit is in capability subclass VIw, nonirrigated.

7-Brinegar loam, 0 to 1 percent slopes. This is a very deep, moderately well drained soil that formed in mixed alluvium. It is on alluvial fans and terraces. The elevation ranges from 5,000 to 6,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is dark gray loam about 14 inches thick. The subsoil consists of gray loam and pale brown sandy clay loam and clay loam and is about 19 inches thick. The substratum in the upper part is light brown coarse sandy loam about 7 inches thick. In the lower part it is light brown, reddish brown, and very pale brown gravelly coarse sand to a depth of 60 inches or more. It is mottled between depths of 33 to 60 inches.

Included in mapping are small areas of Brailsford loam, Marshdale loam, and Strom loam.

Permeability is moderately slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is very slow, and the hazard of erosion is none or slight. The water table is at a depth of 36 inches in spring and below a depth of 60 inches late in summer and in fall.

This soil is used for dryfarmed and irrigated alfalfa hay, small grains, pasture, and range. About 95 percent of the acreage is cultivated to alfalfa, spring wheat, and barley. Alfalfa is grown for 10 to 15 years, and small grains are grown for 4 or 5 years.

Normally, the soil is saturated in spring, and fallow is not necessary. Wheat and barley grown every year with fertilizer will yield as well as when grown after fallow without fertilizer, if not better. Stubble mulching, chiseling, weed control, and minimum tillage help to control erosion. Chiseling breaks up the plow pan and thereby promotes better root penetration and aeration.

Cultivated areas of this soil provide habitat for ground squirrel, mourning dove, western meadowlark, killdeer, hawk, and falcon. The rangeland provides habitat for sage grouse throughout the year and for mule deer late in fall and in winter. The native vegetation is bluebunch wheatgrass, Idaho fescue, and big sagebrush.

Stream overflow due to snowmelt and the high water table early in spring are the main limitations to the use of this soil as sites for houses with or without basements and as septic tank absorption fields. Buildings and roads can be designed to offset the limited ability of this soil to support a load.

This map unit is in capability subclass IIIc, nonirrigated, and IIIc, irrigated.

8-Brinegar loam, 1 to 3 percent slopes. This is a very deep, moderately well drained soil that formed in mixed alluvium. It is on alluvial fans and terraces. The elevation ranges from 5,000 to 6,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is dark gray loam about 14 inches thick. The subsoil consists of gray loam and pale brown sandy clay loam and clay loam and is about 19 inches thick. The substratum in the upper part is light brown coarse sandy loam 7 inches thick. In the lower part it is light brown, reddish brown, and very pale brown gravelly coarse sand to a depth of 60 inches or more. It is mottled between depths of 33 and 60 inches.

Included in mapping are small areas of Brailsford loam, Marshdale loam, Simonton loam, and Strom clay loam.

Permeability is moderately slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is very slow to slow, and the hazard of erosion is slight. The water table is at a depth of 36 inches in spring and below a depth of 60 inches late in summer and in fall.

This soil is used for dryfarmed and irrigated alfalfa hay, small grains, pasture, and range. About 95 percent of the

acreage is cultivated to alfalfa, spring wheat, and barley. Alfalfa is grown for 10 to 15 years, and small grains are grown for 4 to 5 years.

Normally, the soil is saturated in spring, and fallow is not necessary. Wheat and barley grown every year with fertilizer will yield as well as when grown after fallow without fertilizer, if not better. Stubble mulching, chiseling, weed control, and minimum tillage help to control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan and thereby promotes better root penetration and aeration.

Cultivated areas of this soil are well suited to use as habitat for ground squirrel, mourning dove, western meadowlark, killdeer, hawk, and falcon. The rangeland provides habitat for sage grouse throughout the year and for mule deer late in fall and in winter. The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush.

Stream overflow due to snowmelt and the high water table early in spring are the main limitations to the use of this soil as sites for houses with or without basements and as septic tank absorption fields. Buildings and roads can be designed to offset the limited ability of this soil to support a load.

This map unit is in capability subclass IIIe, irrigated, and IIIc, nonirrigated.

9-Brinegar loam, 3 to 7 percent slopes. This is a very deep and moderately well drained soil that formed in mixed alluvium. It is on alluvial fans and terraces. The elevation ranges from 5,000 to 6,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees, and the frost-free period is about 80 days.

Typically, the surface layer is dark gray loam about 14 inches thick. The subsoil is gray loam and pale brown sandy clay loam and clay loam about 19 inches thick. The substratum in the upper part is light brown coarse sandy loam 7 inches thick. In the lower part it is light brown, reddish brown, and very pale brown gravelly coarse sand to a depth of 60 inches or more.

Included in mapping are small areas of Simonton loam and Vodermaier gravelly coarse sandy loam.

Permeability is moderately slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is medium, and the hazard of erosion is slight to moderate. The water table is at a depth of 40 inches in spring and below a depth of 60 inches late in summer and in fall.

This soil is used for dryfarmed and irrigated alfalfa hay, small grains, pasture, and range. About 70 percent of the acreage is cultivated to alfalfa, spring wheat, and barley. In most years there is sufficient moisture for annual cropping in the dryfarmed areas. On dryfarmed cropland, the rotation is alfalfa for 10 to 15 years and small grains for 4 to 5 years. On irrigated cropland, the rotation includes alfalfa for 10 to 12 years and small grains for 2 to 3 years. Some of the grain is grown in a crop-fallow rotation to control weeds.

Stubble mulching, chiseling, weed control, and minimum tillage help to control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan and thereby promotes better root penetration and aeration.

Cultivated areas of this soil are well suited to use as habitat for ground squirrel, mourning dove, western meadowlark, killdeer, hawk, and falcon. The rangeland provides habitat for sage grouse throughout the year and for mule deer late in fall and in winter. The native vegetation is dominated by bluebunch wheatgrass, Idaho fescue, and big sagebrush.

The high water table and stream overflow due to snowmelt are the main limitations to the use of this soil as sites for buildings and as septic tank absorption fields. The limited ability of this soil to support a load, the high water table, and frost action are limitations to the use of this soil as sites for roads; however, roads can be designed to offset these limitations.

This map unit is in capability subclass IIIe, nonirrigated and irrigated.

10-Earcree gravelly coarse sandy loam, 5 to 25 percent slopes. This is a deep and very deep, well drained soil that formed in material that weathered from granite or andesite. It is on north-facing side slopes on uplands. The elevation ranges from 5,000 to 7,000 feet. The average annual precipitation is 18 inches, the average annual temperature is 39 degrees F, and the frost-free period is about 70 days.

Typically, the surface layer is dark grayish brown gravelly coarse sandy loam about 33 inches thick. The underlying material in the upper 17 inches is light brownish gray gravelly loamy coarse sand; and below that, to a depth of 60 inches or more, it is light olive gray and light yellowish brown loamy coarse sand.

Included in mapping are areas of Lockman stony sandy loam, Roanhide coarse sandy loam, and Rock outcrop.

Permeability is moderately rapid. The root zone extends to a depth of 50 to 60 inches or more. The available water capacity is high. Surface runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used mainly for range, and it provides habitat for sage grouse, mule deer, snowshoe rabbit, and ground squirrel. The native vegetation consists mainly of bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice, and it can be done late in fall or early in spring.

Slope is the main limitation to the construction of buildings and roads.

This map unit is in capability subclass IVe, nonirrigated.

11-Earcree gravelly coarse sandy loam, 25 to 60 percent slopes. This is a deep and very deep, well drained soil that formed in material that weathered from granite or andesite. It is on north-facing side slopes on uplands. The elevation ranges from 5,400 to 8,200 feet. The average annual precipitation is 18 inches, the average annual temperature is 39 degrees F, and the frost-free period is about 70 days.

Typically, the surface layer is dark grayish brown gravelly coarse sandy loam about 33 inches thick. The underlying material in the upper 17 inches is light brownish gray gravelly loamy coarse sand; and below that, to a depth of 60 inches or more, it is light olive gray and light yellowish brown loamy coarse sand.

Included in mapping are areas of Roanhide coarse sandy loam, Lockman stony sandy loam, and Rock outcrop.

Permeability is moderately rapid. The root zone extends to a depth of 50 to 60 inches or more. The available water capacity is very high. Surface runoff is rapid to very rapid, and the hazard of erosion is high.

This soil is used for range, and it provides habitat for sage grouse, mule deer, snowshoe rabbit, and ground squirrel. The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding by conventional methods is limited by the steepness of slope.

Slope is the main limitation to use of this soil as sites for buildings.

This map unit is in capability subclass VIIe, nonirrigated.

12-Earcree-Roanhide complex, 25 to 60 percent slopes. This complex is on hills and mountains. The elevation ranges from 5,400 to 8,200 feet.

The Earcree soil makes up about 50 percent of the complex, and the Roanhide soil makes up about 40 percent. Areas of Rock outcrop, areas of a soil that is similar to the Earcree soil but is less than 40 inches deep to bedrock, and areas of a soil that is similar to the Roanhide soil but is less than 20 inches deep to bedrock make up the rest. The Earcree soil is on northeast-facing side slopes, and the Roanhide soil is on southwest-facing side slopes; however, it was not practical to map the soils separately at the scale of mapping that was used.

The Earcree soil is deep to very deep and well drained. It formed in material that derived from granite and andesite. The average annual precipitation is 18 inches, the average annual temperature is 39 degrees F, and the frost-free period is about 70 days. Typically, the surface layer is dark grayish brown gravelly coarse sandy loam 33 inches thick. The underlying material in the upper 17 inches is light brownish gray gravelly loamy coarse sand; below that, to a depth of 60 inches or more, it is light olive gray or light yellowish brown loamy coarse sand.

Permeability of the Earcree soil is moderately rapid. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is very rapid, and the hazard of erosion is very high.

The Roanhide soil is moderately deep and well drained. It formed in residuum of granite. The average annual precipitation is 14 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 85 days. Typically, the surface layer is grayish brown coarse sandy loam 9 inches thick. The subsoil is brown coarse sandy loam 6 inches thick. The substratum is light brownish gray coarse sandy loam 7 inches thick. It is underlain by granite.

Permeability of the Roanhide soil is moderately rapid. The root zone extends to a depth of 20 to 40 inches. The available water capacity is moderate. Surface runoff is rapid to very rapid, and the hazard of erosion is very high.

These soils are used for range, and they provide habitat for sage grouse, mule deer, snowshoe rabbit, and ground squirrel.

The native vegetation on the Earcree soil is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. The native vegetation on the Roanhide soil is mainly bluebunch wheatgrass and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding and mechanical brush control by conventional methods are not practical because of the steep slopes.

Slope and, in the Roanhide soil, depth to bedrock are the main limitations to the use of the soils for engineering purposes.

This complex is in capability subclass VIe, nonirrigated.

13-Elkcreek loam, 0 to 30 percent slopes. This is a moderately deep, well drained soil that formed in residuum of rhyolite, andesite, and basalt. It is on uplands. The elevation ranges from 5,000 to 6,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is brown and pale brown clay loam and loam 23 inches thick. It is underlain by bedrock.

Included in mapping are small areas of Gaib very gravelly loam, Polecreek very gravelly loam, Simonton loam, and Winu stony loam.

Permeability is moderately slow. The root zone extends to a depth of 26 to 40 inches. The available water capacity is high. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

Most of the acreage is rangeland. A small acreage is used for dryfarmed alfalfa hay and small grains. In rota-

tion, alfalfa is grown for 10 to 15 years and spring wheat or barley is grown for 2 or 3 years.

Stubble mulching, chiseling, weed control, and minimum tillage help to control erosion and produce a favorable growth of crops. There is adequate moisture for annual cropping; therefore, this soil does not need a small grain-fallow rotation except for weed control.

The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range deteriorates, the proportion of grasses decreases, the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice, and it can be done late in fall or early in spring. The rangeland provides habitat for sage grouse, ground squirrel, elk, and mule deer.

Slope and depth to bedrock are the main limitations to the use of this soil as sites for buildings.

This map unit is in capability subclass VIe, nonirrigated.

14-Elkcreek-Gaib complex, 0 to 30 percent slopes. This complex is on uplands. The elevation ranges from 5,000 to 8,200 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

The Elkcreek soil makes up about 45 percent of the complex, and the Gaib soil makes up about 40 percent. Areas of Simonton loam, Winu stony loam, and Rock outcrop make up the rest. The Elkcreek soil is on side slopes and on swells, and the Gaib soil is on ridgetops; however, it was not practical to map the soils separately at the scale of mapping that was used.

The Elkcreek soil is moderately deep and well drained. It formed in residuum of andesite, rhyolite, and basalt. Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is brown and pale brown loam and clay loam about 23 inches thick. It is underlain by bedrock.

Permeability of the Elkcreek soil is moderately slow. The available water capacity is high. The root. zone extends to a depth of 26 to 40 inches. Surface runoff is medium to rapid, and the hazard of erosion is high.

The Gaib soil is shallow and well drained. It formed in residuum of andesite, rhyolite, and basalt. Typically, the surface layer is grayish brown very gravelly loam about 4 inches thick. The subsoil in the upper part is brown very cobbly sandy clay loam 5 inches thick. In the lower part it is brown very stony clay loam about 4 inches thick. It is underlain by bedrock.

Permeability of the Gaib soil is moderately slow. The root zone extends to a depth of 10 to 20 inches. The available water capacity is very low. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

The soils in this complex are used for range, and they provide habitat for ground squirrel, sage grouse, elk, mule deer, rabbit, coyote, falcon, hawk, and eagle. The native vegetation on the Elkcreek soil, is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. The native vegetation on the Gaib soil is mainly bluebunch wheatgrass and low sagebrush.

If the range deteriorates, the proportion of bluebunch wheatgrass decreases, the proportion of forbs and sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice on the Elkcreek soil. Mechanical brush management and seeding are not practical on the Gaib soil because of large stones and the shallowness to bedrock.

Slope, depth to bedrock, and, on the Gaib soil, large stones are the main limitations to the use of these soils as sites for buildings.

This complex is in capability subclass VIe, nonirrigated.

15-Elkcreek-Manard complex, 0 to 30 percent slopes. This complex is on uplands and lava plains. The elevation ranges from 5,200 to 6,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

The Elkcreek soil makes up about 45 percent of the complex, and the Manard soil makes up about 35 percent. Areas of Gaib very gravelly loam, Polecreek very gravelly loam, and Rock outcrop make up the rest.

The Elkcreek soil is moderately deep and well drained. It formed in residuum of andesite, rhyolite, and basalt. Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is brown and pale brown loam and clay loam about 23 inches thick. It is underlain by bedrock.

Permeability of the Elkcreek soil is moderately slow. The root zone extends to a depth of 26 to 40 inches. The available water capacity is high. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

The Manard soil is moderately deep and well drained. It formed in residuum of basalt and rhyolite. Typically, the surface layer is grayish brown silt loam about 9 inches thick. The subsoil is pale brown silty clay loam and light yellowish brown silty clay about 17 inches thick. The substratum is a white, silica-cemented hardpan. It is underlain by bedrock at a depth of 28 inches.

Permeability of the Manard soil is very slow. The root zone extends to a depth of 20 to 38 inches. The available water capacity is moderate. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate.

These soils are used for range, and they provide habitat for ground squirrel, sage grouse, mule deer, rabbit, coyote, falcon, and hawk. The native vegetation on the Elkcreek soil is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. The native vegetation on the Manard soil is mainly Idaho fescue and alkali sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and sagebrush increases, and weeds and other undesirable

Seeding is a suitable practice on the Elkcreek soil, but it is limited on the Manard soil by the shallowness to the heavy clay subsoil. Seeding by conventional methods is limited by the included Rock outcrop, which is mostly in areas of the Manard soil.

Slope, depth to bedrock, and, in the Manard soil, the shallowness to the clay subsoil are the main limitations of these soils for use as sites for buildings.

This complex is in capability subclass VIe, nonirrigated.

16-Elkcreek-Polecreek complex, 0 to 30 percent slopes. This complex is on uplands and lava plains. The elevation ranges from 4,800 to 6,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

The Elkcreek soil makes up about 50 percent of the complex, and the Polecreek soil makes up about 30 percent. Areas of Gaib very gravelly loam, Simonton loam, Manard stony silt loam, and Rock outcrop make up the rest.

The Elkcreek soil is moderately deep and well drained. It formed in residuum of andesite, rhyolite, and basalt. Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is brown and pale brown loam and clay loam about 23 inches thick. Bedrock is at a depth of 31 inches.

Permeability of the Elkcreek soil is moderately slow. The root zone extends to a depth of 26 to 40 inches. The available water capacity is high. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

The Polecreek soil is shallow and well drained. It formed in residuum of basalt and rhyolite. Typically, the surface layer in the upper part is brown very gravelly loam about 4 inches thick; and in the lower part it is brown very cobbly clay about 9 inches thick. It is underlain by bedrock.

Permeability of the Polecreek soil is slow. The root zone extends to a depth of 10 to 20 inches. The available water capacity is low. Surface runoff is very slow to rapid, and the hazard of erosion is slight to high.

These soils are used for range, and they provide habitat for sage grouse, ground squirrel, mule deer, coyote, falcon, and hawk. The native vegetation on the Elkcreek soil is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. The native vegetation on the Polecreek soil is mainly bluebunch wheatgrass and low sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice on the Elkcreek soil, but it is limited on the Polecreek soil by stones and the shallowness to bedrock.

Slope and depth to bedrock are the main limitations to the use of these soils for engineering purposes. This complex is in capability subclass VIe, nonirrigated.

17-Elkcreek-Rock outcrop complex, 0 to 30 percent slopes. This complex is on uplands. The elevation ranges from 5,000 to 6,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

The Elkcreek soil makes up 60 percent of the complex, and Rock outcrop makes up 20 percent. Areas of Gaib very gravelly loam and Simonton loam make up the rest.

The Elkcreek soil is moderately deep and well drained. It formed in residuum of rhyolite, basalt, and andesite. Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is brown and pale brown loam and clay loam about 23 inches thick. It is underlain by bedrock.

Permeability is moderately slow. The root zone is 26 to 40 inches deep. The available water capacity is high. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

Rock outcrop consists of exposed andesite, basalt, and rhyolite bedrock. In places, very shallow soil material covers the bedrock. This soil material supports little or no vegetation.

This complex is used for range, and it provides habitat for ground squirrel, rockchuck, rabbit, sage grouse, mule deer, elk, hawk, and falcon. The native vegetation is dominated by bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of big sagebrush and forbs increases, and weeds and other undesirable annual plants become more abundant. Mechanical brush control and seeding are not practical because of the large amount of Rock outcrop and surface stones.

Slope and depth to bedrock are the main limitations to the use of the Elkcreek soil for engineering purposes.

This complex is in capability subclass VIs, nonirrigated.

18-Elkcreek-Rock outcrop complex, 30 to 60 percent slopes. This complex is on uplands. The elevation ranges from 5,000 to 6,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

The Elkcreek soil makes up 60 percent of the complex, and Rock outcrop makes up 30 percent. Areas of Gaib very gravelly loam and Winu stony loam make up the rest.

The Elkcreek soil is moderately deep and well drained. It formed in residuum of rhyolite, basalt, and andesite. Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is brown and pale brown loam and clay loam 23 inches thick. It is underlain by bedrock.

Permeability is moderately slow. The root zone extends to a depth of 26 to 40 inches. The available water capacity is high. Surface runoff is rapid to very rapid, and the hazard of erosion is high to very high.

Rock outcrop consists of exposed andesite, basalt, and rhyolite bedrock. In places, very shallow soil material covers the bedrock. This soil material supports little or no vegetation.

This complex is used for range, and it provides habitat for ground squirrel, rockchuck, rabbit, sage grouse, mule deer, elk, hawk, and falcon. The native vegetation is mainly bluebunch wheatgrass and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass decreases, the proportion of big sagebrush and forbs increases, and weeds and other undesirable annual plants become more abundant. Mechanical brush control and seeding are not practical because of the large amount of Rock outcrop and surface stones and because of the steepness of slope.

Slope and depth to bedrock are the main limitations to the use of the Elkcreek soil for engineering purposes.

This complex is in capability subclass VIIs, nonirrigated.

19-Gaib-Elkcreek complex, 0 to 30 percent slopes. This complex is on uplands. The elevation ranges from 5,000 to 7,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 80 days.

The Gaib soil makes up about 45 percent of the complex, and the Elkcreek soil makes up about 35 percent. Areas of Simonton loam, Polecreek very gravelly loam, and Rock outcrop make up the rest.

The Gaib soil is on ridges. It is shallow and well drained. It formed in residuum of andesite, rhyolite, and basalt. Typically, the surface layer is grayish brown very gravelly loam about 4 inches thick. The subsoil in the upper part is brown very cobbly sandy clay loam 5 inches thick. In the lower part it is brown very stony clay loam 4 inches thick. It is underlain by bedrock.

Permeability of the Gaib soil is moderately slow. The root zone extends to a depth of 10 to 20 inches. The available water capacity is very low. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

The Elkcreek soil is on side slopes. It is moderately deep and well drained. It formed in residuum of andesite, rhyolite, and basalt. Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is brown and pale brown loam and clay loam 23 inches thick. It is underlain by bedrock.

Permeability of the Elkcreek soil is moderately slow. The root zone extends to a depth of 26 to 40 inches. The available water capacity is high. Surface runoff is slow to rapid, and the erosion hazard is slight to high.

These soils are used for range, and they provide habitat for ground squirrel, rockchuck, rabbit, sage grouse, mule deer, elk, hawk, and falcon. The native vegetation on the Gaib soil is mainly bluebunch wheatgrass and low sagebrush. The native vegetation on the Elkcreek soil is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and sagebrush increases, and weeds and other undesirable annual plants become more abundant. Mechanical brush control and seeding are not practical on the Gaib soil because of the large stones and shallowness to bedrock. Seeding is a suitable practice on the Elkcreek soil.

Depth to rock and slope are the main limitations to the use of these soils as sites for buildings and roads.

This complex is in capability subclass VIs, nonirrigated.

20-Gaib-Elkcreek complex, 30 to 60 percent slopes. This complex is on uplands. The elevation ranges from 5,000 to 8,200 feet. The average annual precipitation is 14 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 80 days.

The Gaib soil makes up about 55 percent of the complex, and the Elkcreek soil makes up about 25 percent. Areas of Gaib very gravelly loam, 0 to 30 percent slopes, Winu stony loam, Polecreek very gravelly loam, and Rock outcrop make up the rest.

The Gaib soil is shallow and well drained. It formed in residuum of andesite, rhyolite, and basalt. Typically, the surface layer is grayish brown very gravelly loam about 4 inches thick. The subsoil in the upper part is brown very cobbly sandy clay loam 5 inches thick. In the lower part it is brown very stony clay loam 4 inches thick. It is underlain by bedrock.

Permeability of the Gaib soil is moderately slow. The root zone extends to a depth of 10 to 20 inches. The available water capacity is very low. Surface runoff is rapid to very rapid, and the hazard of erosion is high to very high.

The Elkcreek soil is moderately deep and well drained. It formed in residuum of andesite, rhyolite, and basalt. Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is brown and pale brown loam and clay loam 23 inches thick. It is underlain by bedrock.

Permeability of the Elkcreek soil is moderately slow. The root zone extends to a depth of 26 to 40 inches. The available water capacity is moderate to high. Surface runoff is rapid to very rapid, and the hazard of erosion is high to very high.

These soils are used for range, and they provide habitat for ground squirrel, rockchuck, rabbit, sage grouse, mule deer, elk, hawk, and falcon. The native vegetation on the Gaib soil is mainly bluebunch wheatgrass and low sagebrush. The native vegetation on the Elkcreek soil is mainly bluebunch wheatgrass and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass decreases, the proportion of forbs and sagebrush increases, and weeds and other undesirable annual plants become more abundant. Mechanical brush control and seeding are not practical on these soils because of steep slopes.

This complex is in capability subclass VIIs, nonirrigated.

21-Gaib-Rock outcrop complex, 0 to 25 percent slopes. This complex is on uplands. The elevation ranges from 5,000 to 7,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 80 days.

The Gaib soil makes up 60 percent of the complex, and Rock outcrop makes up 20 percent. Areas of Elkcreek loam, Polecreek very gravelly loam, and Simonton loam make up the rest.

The Gaib soil is shallow and well drained. It formed in residuum of andesite, basalt, and rhyolite. Typically, the surface layer is grayish brown very gravelly loam about 4 inches thick. The subsoil in the upper part is brown very cobbly sandy clay loam 5 inches thick. In the lower part, it is brown very stony clay loam 4 inches thick. It is underlain by bedrock.

Permeability of the Gaib soil is moderately slow. The root zone extends to a depth of 10 to 20 inches. The available water capacity is very low. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

Rock outcrop consists of exposed andesite, basalt, and rhyolite bedrock. In places, very shallow soil material covers the bedrock. This soil material supports little or no vegetation.

This complex is used for range, and it provides habitat for rockchuck, rabbit, and mule deer. The native vegetation is mainly bluebunch wheatgrass and low sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass decreases, the proportion of low sagebrush and forbs increases, and weeds and other undesirable annual plants become more abundant. Mechanical brush control and seeding are not practical because of the large amount of Rock outcrop and surface stones and because of the shallowness to bedrock.

Shallowness to bedrock, slope, and large stones are the main limitations to the construction of buildings and roads.

This complex is in capability subclass Vls, nonirrigated.

22-Gaib-Rock outcrop complex, 25 to 60 percent slopes. This complex is on uplands. The elevation ranges from 5,000 to 8,200 feet. The average annual precipitation is 14 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 80 days.

The Gaib soil makes up 60 percent of the complex, and Rock outcrop makes up 20 percent. Areas of Gaib very gravelly loam, 0 to 25 percent slopes, Elkcreek loam, Winu stony loam, and Polecreek very gravelly loam make up the rest.

The Gaib soil is shallow and well drained. It formed in residuum of andesite, basalt, and rhyolite. Typically, the surface layer is grayish brown very gravelly loam about 4 inches thick. The subsoil in the upper part is brown very cobbly sandy clay loam about 5 inches thick. In the lower part it is brown very stony clay loam 4 inches thick. It is underlain by bedrock.

Permeability is moderately slow. The root zone extends to a depth of 10 to 20 inches. The available water capacity is very low. Surface runoff is rapid to very rapid, and the hazard of erosion is high to very high.

Rock outcrop consists of exposed andesite, basalt, and rhyolite bedrock. In places, very shallow soil material covers the bedrock. This soil material supports little or no vegetation.

This complex is used for range, and it provides habitat for rockchuck, rabbit, and mule deer. The native vegetation on the Gaib soil is mainly bluebunch wheatgrass and low sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass decreases, the proportion of low sagebrush and forbs increases, and weeds and other undesirable annual plants become more abundant. Mechanical brush control and seeding are not practical because of the steepness of slope, shallowness to bedrock, and surface stones.

The steepness of slope, shallowness to rock, and large stones are the main limitations to the construction of buildings and roads.

This complex is in capability subclass VIIs, nonirrigated.

23-Gaib-Winu complex, 30 to 60 percent slopes. This complex is on uplands. The elevation ranges from 5,000 to 7,500 feet.

The Gaib soil is on south-facing side slopes and makes up about 50 percent of the complex, and the Winu soil is on north-facing side slopes and makes up 30 percent. Areas of Gaib very gravelly loam, 0 to 30 percent slopes, Elkcreek loam, Polecreek very gravelly loam, and Rock outcrop make up the rest.

The Gaib soil is shallow and well drained. It formed in residuum of andesite, rhyolite, and basalt. The average annual precipitation is 14 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 80 days. Typically, the surface layer is grayish brown very gravelly loam about 4 inches thick. The subsoil in the upper part is brown very cobbly sandy clay loam 5 inches thick. In the lower part, it is brown very stony clay loam. It is underlain by bedrock.

Permeability of the Gaib soil is moderately slow. The root zone extends to a depth of 10 to 20 inches. The available water capacity is very low. Surface runoff is rapid to very rapid, and the hazard of erosion is high to very high.

The Winu soil is moderately deep and well drained. It formed in residuum and colluvium that derived from rhyolite and basalt. The average annual precipitation is 16 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 60 days. Typically, the surface layer is dark gray stony loam and grayish brown gravelly loam about 17 inches thick. The subsoil in the upper part is grayish brown gravelly loam 5 inches thick. In the lower part it is brown gravelly loam 4 inches thick. The substratum is yellowish brown very gravelly loam 8 inches thick. It is underlain by bedrock.

Permeability of the Winu soil is moderately slow. The root zone extends to a depth of 24 to 40 inches. The available water capacity is moderate. Surface runoff is very rapid, and the hazard of erosion is high to very high.

These soils are used for range, and they provide habitat for ground squirrel, rockchuck, rabbit, sage grouse, mule deer, elk, hawk, and falcon. The native vegetation on the Gaib soil is bluebunch wheatgrass and low sagebrush. The native vegetation on the Winu soil is mainly basin wildrye, bluebunch wheatgrass, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass decreases, the proportion of forbs and sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding and mechanical brush control are limited by steep slopes and large stones.

Slope, depth to rock, and, in the Gaib soil, large stones are the main limitations to the construction of buildings and roads.

This complex is in capability subclass VIIs, nonirrigated.

24-Harahill loam, 0 to 12 percent slopes. This is a moderately deep, well drained soil that formed in residuum of basalt and rhyolite. It is on lava plains and uplands. The elevation ranges from 5,000 to 6,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 42 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is brown loam about 12 inches thick. The subsoil in the upper part is brown loam 8 inches thick. In the lower part it is brown very gravelly loam 6 inches thick. The substratum is disintegrating bedrock 3 inches thick. It is underlain by bedrock.

Included in mapping are small areas of Elkcreek loam, Laurentzen loam, Gaib very gravelly loam, and Polecreek very gravelly loam.

Permeability is moderately slow. The root zone extends to a depth of 24 to 36 inches. The available water capacity is moderate. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used entirely for range. The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Mechanical brush control and seeding are suitable practices. Seeding can be done late in fall or early in spring.

This soil provides habitat for sage grouse, snowshoe rabbit and ground squirrel. Areas of big sagebrush are particularly suited to habitat for sage grouse.

Depth to bedrock is the main limitation to the use of this soil as sites for buildings and roads.

This map unit is in capability subclass IVe, nonirrigated.

25-Harahill-Gaib complex, 0 to 30 percent slopes. This complex is on lava plains and uplands. The elevation ranges from 5,000 to 6,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

The Harahill soil makes up about 50 percent of the complex, and the Gaib soil makes up about 30 percent. Areas of Elkcreek loam, Polecreek very gravelly loam, Laurentzen loam, and Rock outcrop make up the rest.

The Harahill soil is moderately deep and well drained. It formed in residuum of basalt and rhyolite. Typically, the surface layer is brown loam about 12 inches thick. The subsoil in the upper part is brown loam 8 inches thick. In the lower part it is brown very gravelly loam 6 inches thick. The substratum consists of disintegrating bedrock and is 3 inches thick. It is underlain by bedrock.

Permeability of the Harahill soil is moderately slow. The root zone extends to a depth of 24 to 36 inches. The available water capacity is moderate. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

The Gaib soil is shallow and well drained. It formed in residuum of andesite, basalt, and rhyolite. Typically, the surface layer is grayish brown very gravelly loam 4 inches thick. The subsoil in the upper part is brown very cobbly sandy clay loam 5 inches thick. In the lower part it is brown very stony clay loam 4 inches thick. It is underlain by bedrock.

Permeability of this soil is moderately slow. The root zone extends to a depth of 10 to 20 inches. The available water capacity is very low. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

These soils are used for range. The native vegetation on the Harahill soil is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. The native vegetation on the Gaib soil is mainly bluebunch wheatgrass and low sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Mechanical brush control and seeding are practical on the Harahill soil. These practices are not suitable for the Gaib soil because of large stones and the shallowness to bedrock.

These soils provide habitat for ground squirrel, rockchuck, rabbit, sage grouse, mule deer, elk, hawk, and falcon. Areas of sagebrush are particularly suited to habitat for sage grouse.

Slope and depth to rock are the main limitations to the use of these soils as sites for buildings and roads.

This complex is in capability subclass VIe, nonirrigated.

26-Harahill-Polecreek complex, 0 to 30 percent slopes. This complex is on lava plains and uplands. The elevation ranges from 5,000 to 6,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

The Harahill soil makes up 50 percent of the complex, and the Polecreek soil makes up 30 percent. Areas of Elkcreek loam, Gaib very gravelly loam, Laurentzen loam, and Rock outcrop make up the rest.

The Harahill soil is moderately deep and well drained. It formed in residuum of basalt and rhyolite. Typically, the surface layer is brown loam about 12 inches thick. The subsoil in the upper part is brown loam 8 inches thick. In the lower part it is brown very gravelly loam 6 inches thick. The substratum consists of disintegrating bedrock and is 3 inches thick. It is underlain by bedrock.

Permeability of the Harahill soil is moderately slow. The root zone extends to a depth of 24 to 36 inches. The available water capacity is moderate. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

The Polecreek soil is shallow and well drained. It formed in residuum of rhyolite and basalt. Typically, the surface layer is brown very gravelly and very cobbly loam about 9 inches thick. The subsoil is light brown very cobbly clay 9 inches thick. It is underlain by bedrock.

Permeability of the Polecreek soil is slow. The root zone extends to a depth of 10 to 20 inches. The available water capacity is low. Surface runoff is very slow to rapid, and the hazard of erosion is slight to high.

These soils are used for range. The native vegetation on the Harahill soil consists of bluebunch wheatgrass, Idaho fescue, and big sagebrush. The native vegetation on the Polecreek soil consists of Sandberg bluegrass, bluebunch wheatgrass, and low sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and sagebrush increases, and weeds and other undesirable annual plants become more abundant. Mechanical brush control and seeding are practical on the areas of Harahill soil that are not too stony. Mechanical brush control and seeding are not practical on the Polecreek soil because of pebbles, stones, and cobblestones in the surface layer.

These soils provide habitat for sage grouse, ground squirrel, mule deer, coyote, falcon, and hawk. Areas of big sagebrush are particularly suited to habitat for sage grouse.

Slope, shrink-swell potential, and depth to bedrock are the main limitations to the use of these soils as sites for buildings and roads.

This complex is in capability subclass IVe, nonirrigated.

27-Houk silty clay loam. This is a very deep, somewhat poorly drained soil that formed in mixed alluvium. It is on low terraces and bottom lands. The slopes are 0 to 2 percent. The elevation ranges from 5,000 to 5,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is gray silty clay loam about 8 inches thick. The subsurface layer is gray silty clay loam about 5 inches thick. The subsoil in the upper 18 inches is dark gray clay; and in the lower 15 inches it is gray, calcareous clay loam. The substratum in the upper part is light gray, calcareous sandy clay loam 11 inches thick. In the lower part, to a depth of 60 inches or more, it is gray, noncalcareous sandy loam. Mottles are at a depth of 30 to 46 inches.

Included in mapping are small areas of Brailsford loam, Brinegar loam, Marshdale loam, and Strom loam.

Permeability is slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is very slow, and the hazard of erosion is none to slight. The water table is at a depth of 30 inches in spring and at a depth of 60 inches late in summer and in fall.

About 75 percent of the acreage of this map unit is cultivated to alfalfa, spring wheat, and barley. The rest is used for nonirrigated pasture and range.

In most years, there is sufficient moisture for annual cropping, and, in rotation, alfalfa is grown for 10 to 12 years and small grains are grown for 2 to 4 years. Some of the small grain is grown in a crop-fallow system to control weeds. Stubble mulching, chiseling, weed control, and minimum tillage help to control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan and thereby promotes better root penetration and improves aeration.

The native vegetation is mainly Nebraska sedge, rush, tufted hairgrass, and redtop. If properly managed, these plants will remain in the composition.

This soil provides habitat for curlew, avocet, phalarope, sandhill crane, killdeer, duck, marsh hawk, and mule deer. Canadian geese feed in the grain fields in fall.

The high water table and stream overflow during snowmelt are the main limitations to the use of this soil as sites for buildings and as septic tank filter fields.

This map unit is in capability subclass IIIw, irrigated and nonirrigated.

28-Kevanton sandy loam, 0 to 5 percent slopes. This is a deep and very deep, well drained soil that formed in eolian sand over bedrock. It is on lava plains. The elevation ranges from 4,800 to 5,200 feet. The average annual precipitation is 13 inches, the average annual air temperature is 43 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is brown sandy loam about 11 inches thick. The subsoil in the upper 14 inches is pale brown sandy loam; in the middle 9 inches it is pale brown sandy clay loam; and in the lower 10 inches it is brown clay. The substratum is reddish yellow and light brown loam to a depth of 60 inches or more.

Included in mapping are small areas of Magic very stony silty clay, Manard silt loam, Harahill loam, and Rock outcrop.

Permeability is very slow. The root zone extends to a depth of 44 to 60 inches or more. The available water capacity is very high. Surface runoff is slow. The hazard

of erosion by water is none to slight and by wind, moderate.

About 25 percent of the acreage is dryfarmed cropland. The rest is rangeland and nonirrigated pasture.

In rotation, alfalfa is grown for 10 to 15 years and small grains are grown for 4 to 5 years. Stubble mulching, chiseling, and minimum tillage help to control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan and thereby improves aeration and promotes better penetration by roots and water.

The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush (fig. 4). If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice on this soil; however, there is a chance of seeding failure because of drought.

This soil supports habitat for sage grouse, ground squirrel, and rockchuck.

Low strength, shrink-swell potential, and the clayey subsoil are the limitations to the use of this soil as sites for buildings and roads.

This map unit is in capability subclass IIIc, nonirrigated, and IIIe, irrigated.

29-Kevanton-Rock outcrop complex, 0 to 25 percent slopes. This complex is on lava plains. The elevation ranges from 4,800 to 5,200 feet. The average annual precipitation is 13 inches, the average annual temperature is 43 degrees F, and the frost-free period is about 85 days.

The Kevanton soil makes up about 55 percent of the complex, and Rock outcrop makes up about 25 percent. Areas of Gaib very gravelly loam, Polecreek very gravelly loam, Manard very stony silt loam, and Magic very stony silty clay make up the rest.

The Kevanton soil is deep and very deep and well drained. It formed in eolian sands and the underlying weathered basalt. Typically, the surface layer is brown sandy loam about 11 inches thick. The subsoil in the upper 14 inches is pale brown sandy loam; in the middle

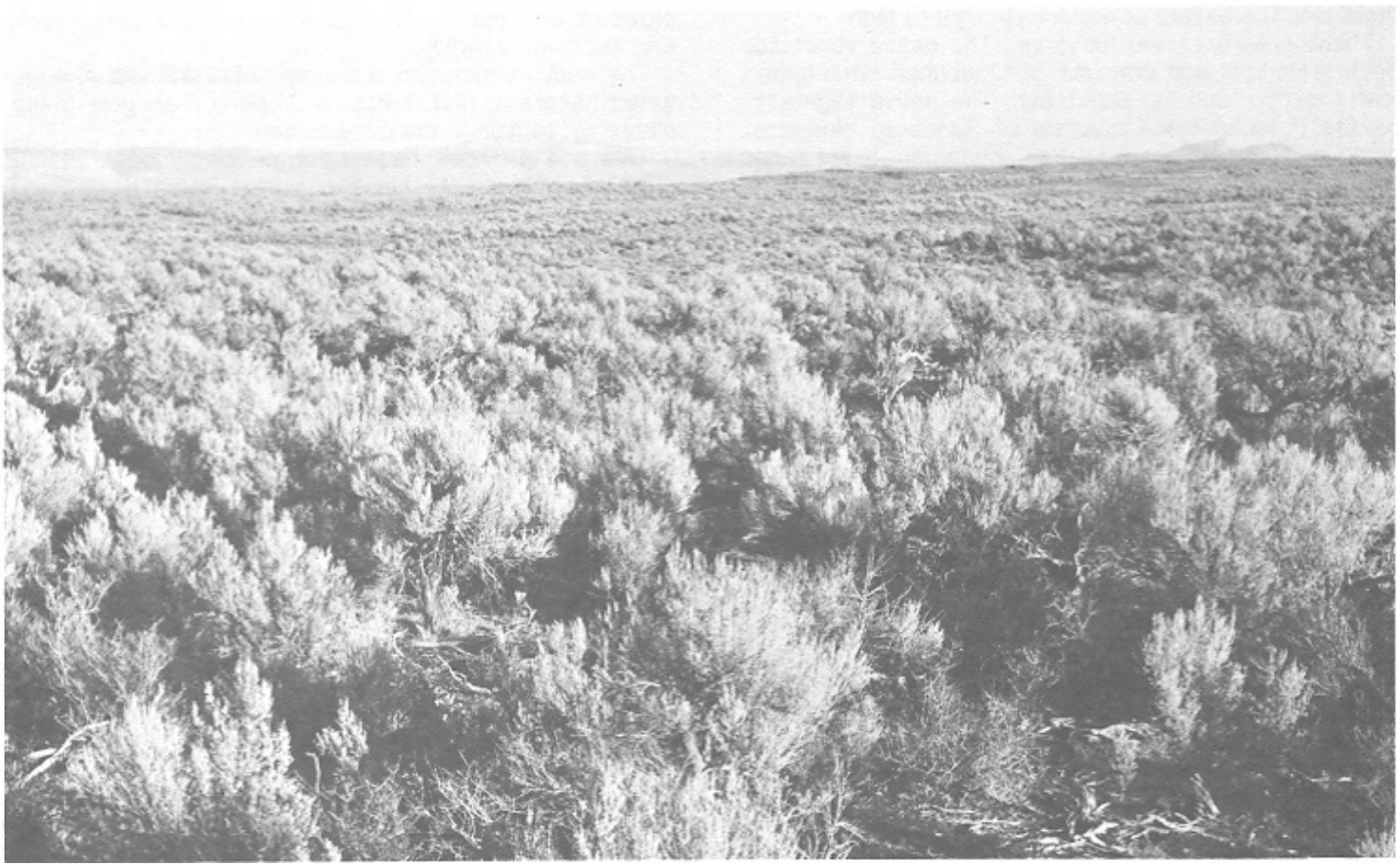

Figure 4.-The area of big sagebrush in the foreground is on Kevanton sandy loam, 0 to 5 percent slopes.

9 inches it is pale brown sandy clay loam; and in the lower 10 inches it is brown clay. The substratum is reddish yellow and light brown loam to a depth of 60 inches or more.

Permeability is very slow. The root zone extends to a depth of 44 to 60 inches or more. The available water capacity is very high. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate.

Rock outcrop consists of exposed basalt bedrock. In places, very shallow soil material covers the bedrock. This soil material supports little or no vegetation.

This complex is used for range, and it provides habitat for sage grouse, ground squirrel, mule deer, coyote, falcon, and hawk. The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice; however, there is a chance of seeding failure because of drought.

Rock outcrop, low strength, and shrink-swell potential are the main limitations to the use of the soil as sites for buildings or roads.

This complex is in capability subclass VIIs, nonirrigated.

30-Laurentzen loam, 0 to 12 percent slopes. This is a very deep and well drained soil that formed in alluvium and in residuum of basalt. It is on alluvial fans and lava plains. The elevation ranges from 4,800 to 5,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is brown loam about 14 inches thick. The subsoil in the upper part is brown clay loam 28 inches thick. In the lower part, to a depth of 60 inches or more, it is brown cobbly clay loam.

Included in mapping are small areas of Harahill loam, Polecreek very gravelly loam, and Rock outcrop.

Permeability is moderately slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used for livestock grazing and wildlife habitat. A very small acreage is used for alfalfa hay and small grains. The precipitation is sufficient to raise a crop each year.

The native vegetation on this soil is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and big sagebrush increases, and weeds and undesirable annual plants become more abundant. Seeding is a suitable practice on this soil.

This soil provides habitat for sage grouse, snowshoe rabbit, and ground squirrel. Areas of big sagebrush are particularly suited to habitat for sage grouse.

Slope and shrink-swell potential are the main limitations to the use of this soil as sites for buildings and roads.

This map unit is in capability subclass IIIe, nonirrigated.

31-Little Wood very gravelly loam, 0 to 4 percent slopes. This is a very deep, well drained soil that formed in mixed alluvium. It is on alluvial fans and terraces. The elevation ranges from 5,000 to 5,300 feet. The average annual precipitation is 14 inches, the average annual temperature is 43 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is grayish brown very gravelly loam about 14 inches thick. The subsoil in the upper part is brown very gravelly sandy clay loam 5 inches thick. In the lower part it is pale brown very gravelly sandy clay loam 11 inches thick. The substratum is pale brown very gravelly loamy coarse sand and very gravelly coarse sand to a depth of 60 inches or more.

Included in mapping are small areas of Brinegar loam, Rands loam, Simonton loam, and Vodermaier gravelly coarse sandy loam.

Permeability is moderate in the subsoil and rapid or very rapid in the substratum. The root zone extends to a depth of 60 inches or more. The available water capacity is moderate. Surface runoff is slow, and the hazard of erosion is slight to moderate.

About 75 percent of the acreage of this map unit is used for alfalfa hay, pasture, and small grains. The rest is used for range.

In most years there is sufficient moisture for annual cropping, and, in rotation, alfalfa hay is grown for 10 to 15 years and small grains are grown for 4 or 5 years. Some of the grain is grown in a crop-fallow system to control weeds. Stubble mulching, weed control, and minimum tillage help control erosion and produce a favorable growth of crops.

The native vegetation on this soil is mainly bluebunch wheatgrass, needlegrasses, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass decreases, the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice on this soil; however, there is a moderate chance of seeding failure because of drought.

This soil provides habitat for sage grouse, snowshoe rabbit, and ground squirrel.

This soil has limitations to use as sites for buildings and roads. Because of the rapid or very rapid permeability of the substratum, effluent from septic tank absorption fields can contaminate ground water.

This map unit is in capability subclass IIIe, irrigated, and IIIc, nonirrigated.

32-Lockman stony sandy loam, 30 to 60 percent slopes. This is a deep, well drained soil that formed in residuum of granite and andesite. It is on mountains and hills. The elevation ranges from 5,000 to 8,200 feet. The

average annual precipitation is 20 inches, the average annual temperature is 38 degrees F, and the frost-free period is about 60 days.

Typically, a layer of leaves, needles, twigs, and cones, about 2 inches thick, is on the surface. The surface layer is dark grayish brown stony sandy loam about 13 inches thick. The subsoil is very pale brown sandy loam 6 inches thick. The substratum is 29 inches thick. In the upper 20 inches it consists of pale olive and light yellowish brown sandy loam, and in the lower 9 inches it is light yellowish brown cobbly sandy loam.

Included in mapping are small areas of a soil that is similar to the Lockman soil but is 20 to 40 inches deep to bedrock, areas of Earcree gravelly coarse sandy loam, and areas of Rock outcrop. Also included are areas of Lockman soils that have slopes of less than 30 percent.

Permeability is moderate. The root zone extends to a depth of 40 to 60 inches. The available water capacity is high. Surface runoff is very rapid, and the hazard of erosion is high.

This soil is used for timber and range, and it provides excellent habitat for mule deer and elk and other large game animals and for blue grouse and songbirds.

This Lockman soil can produce Douglas fir and Ponderosa pine. In 40 years it can produce 3,400 cubic feet per acre. In 130 years it can produce 38,000 board feet per acre based on the cumulative mean annual increment.

The potential plant community consists of Douglas-fir and snowberry. When a stand of trees reaches its potential growth, the canopy covers more than 40 percent of the understory; as a result, the understory plants are sparse and have low value as forage for livestock and wildlife. When the canopy covers 40 percent or less of the understory, the forage is excellent.

Slope is the main limitation to the construction of buildings and roads.

This map unit is in capability subclass VIIe, nonirrigated.

33-Magic very stony silty clay, 0 to 8 percent slopes. This is a moderately deep, well drained soil that formed in residuum of basalt. It is on lava plains. The elevation ranges from 4,800 to 5,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is brown very stony silty clay about 3 inches thick. The subsoil in the upper 13 inches is brown silty clay; in the lower 19 inches it is pinkish gray silty clay and silty clay loam. It is underlain by bedrock.

Included in mapping are small areas of Manard very stony silty loam, Gaib very gravelly loam, and Harahill stony loam. Also included are a few areas of a grayish brown soil that is less than 10 inches deep to basalt.

Permeability is very slow. The root zone extends to a depth of 25 to 40 inches. The available water capacity is high. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used mainly for range, and it provides habitat for sage grouse. Very small areas are irrigated and dryfarmed to alfalfa or small grains. The native vegetation is mainly Idaho fescue, Sandberg bluegrass, and alkali sagebrush. Seeding by conventional methods is not a suitable practice because of the stoniness of the soil.

High shrink-swell potential (fig. 5), low strength, high content of clay, and depth to bedrock are the main limitations to the use of this soil as sites for buildings and roads.

This map unit is in capability subclass IVe, irrigated, and IVe, nonirrigated.

34-Manard silt loam, 0 to 4 percent slopes. This is moderately deep, well drained soil that formed in residuum of basalt or rhyolite. It is on lava plains and hills. The elevation ranges from 4,800 to 6,000 feet. The average

Figure 5.-These cracks in Magic very stony silty clay, 0 to 8 percent slopes, are 1 to 3 inches wide and 12 to 16 inches deep.

annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is grayish brown silt loam and silty clay loam 9 inches thick. The subsoil in the upper 9 inches is pale brown silty clay loam; in the lower 8 inches it is light yellowish brown silty clay. The substratum is a white, silica-cemented hardpan 2 inches thick. It is underlain by bedrock (fig. 6).

Included in mapping are areas of Magic very stony silty clay, Kevanton sandy loam, Polecreek very gravelly loam, Gaib very gravelly loam, a soil that is similar to the Manard soil but has a silty clay subsoil, and Rock outcrop.

Permeability is very slow. The root zone extends to a depth of 20 to 37 inches. The available water capacity is moderate. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used mainly for range, and it provides habitat for sage grouse and mule deer. About 15 percent of the acreage is cropland.

The native vegetation is mainly alkali sagebrush, Sandberg bluegrass, and Idaho fescue. Seeding is usually not practical because of the shallowness to a heavy clay layer.

High shrink-swell potential, low strength, and depth to bedrock and hardpan are the main limitations to the use of this soil as sites for buildings and roads.

This map unit is in capability subclass IIIc, nonirrigated, and IIIe, irrigated.

35-Manard-Rock outcrop complex, 0 to 8 percent slopes. This complex is on lava plains. The elevation ranges from 4,800 to 6,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 85 days.

The Manard soil makes up about 60 percent of the complex, and Rock outcrop makes up about 20 percent. Areas of Magic very stony silty clay, Polecreek very gravelly loam, and Gaib very gravelly loam make up the rest.

The Manard soil is moderately deep and well drained. It formed in residuum of basalt. Typically, the surface layer is grayish brown very stony silt loam and very stony silty clay loam 9 inches thick. The subsoil in the upper 9 inches is pale brown silty clay loam; and in the lower 8 inches it is light yellowish brown silty clay. The substratum is a white silica-cemented duripan 2 inches thick. It is underlain by bedrock.

Permeability is very slow. The root zone extends to a depth of 20 to 37 inches. The available water capacity is moderate. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate.

Rock outcrop consists of exposed basalt bedrock. In places, very shallow soil material covers the bedrock. This soil material supports little or no vegetation.

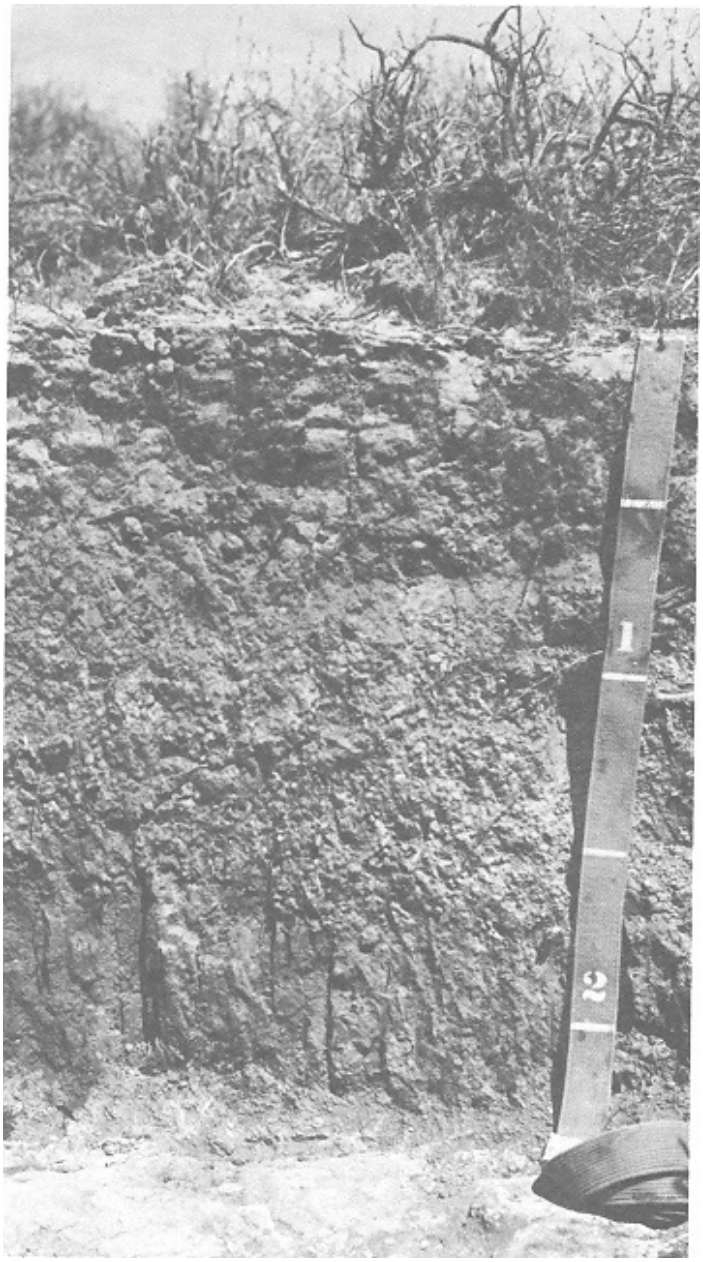

Figure 6.-Profile of Manard silt loam, 0 to 4 percent slopes.

Areas of this complex are used for range, and they provide habitat for sage grouse and mule deer. The native vegetation is alkali sagebrush, Sandberg bluegrass, and Idaho fescue. Seeding is usually not practical because of the Rock outcrop and the shallowness to a heavy subsoil layer.

High shrink-swell potential, large stones, low strength, Rock outcrop, and depth to bedrock are the main limita-

tions to the use of this complex as sites for buildings and roads.

This complex is in capability subclass Vls, nonirrigated.

36-Marshdale loam, 0 to 4 percent slopes. This is a very deep and poorly drained soil that formed in mixed alluvium. It is on bottom lands. The elevation ranges from 4,800 to 5,500 feet. The average annual precipitation is 13 inches, the average annual temperature is 45 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is dark gray loam about 33 inches thick. The underlying material in the upper part is light gray clay loam 14 inches thick; in the middle part, it is light gray loamy coarse sand 13 inches thick; and in the lower part, it is reddish yellow coarse sand to a depth of 60 inches or more.

Included in mapping are small areas of Houk silty clay loam, Strom loam, Strom sandy clay loam, and a soil that is similar to the Marshdale soil but has a sandy loam surface layer.

Permeability is moderately slow in the subsoil and rapid in the substratum. The root zone extends to a depth of 60 inches or more. The available water capacity is moderate. Surface runoff is slow, and the hazard of erosion is none to slight. The water table is at a depth of 1 to 5 feet in spring and summer.

About 75 percent of the acreage is used for small grains, pasture, and alfalfa hay. The rest is used for range.

In most years there is sufficient moisture for annual cropping. Some of the grain is grown in a crop-fallow system to control weeds. Flooding by snowmelt can ruin winter grain; therefore, spring wheat is the best suited grain crop for this soil. Stubble mulching, chiseling, weed control, and minimum tillage help to control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan and thereby promotes better root penetration and improves aeration.

The native vegetation is mainly Nebraska sedge, rush, tufted hairgrass, and slender wheatgrass. If properly managed, these plants will remain in the composition. Seeding is a suitable practice. The seedbed usually needs to be plowed and cropped for a year prior to seeding.

This soil provides habitat for curlew, avocet, phalarope, sandhill crane, killdeer, duck, and marsh hawk.

The high water table and stream overflow during snowmelt are the main limitations to the use of this soil as sites for buildings. The high water table, low strength, and shrinking and swelling break up roads in spring.

This map unit is in capability subclass IVw, nonirrigated, and IVw, irrigated.

37-Polecreek-Harahill complex, 0 to 25 percent slopes. This complex is on uplands and lava plains. The elevation ranges from 5,000 to 6,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is 80 days.

The Polecreek soil makes up about 55 percent of the complex, and the Harahill soil makes up about 25 percent. Areas of Laurentzen loam, Gaib very gravelly loam, Elkcreek loam, and Rock outcrop make up the rest.

The Polecreek soil is shallow and well drained. It formed in residuum of rhyolite or basalt. Typically, the surface layer is brown very gravelly and very cobbly loam 9 inches thick. The subsoil is light brown very cobbly clay 9 inches thick. It is underlain by bedrock.

Permeability of the Polecreek soil is slow. The root zone extends to a depth of 10 to 20 inches. The available water capacity is low. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

This Harahill soil is moderately deep and well drained. It formed in residuum of basalt or rhyolite. Typically, the surface layer is brown stony loam about 12 inches thick. The subsoil is 14 inches thick. In the upper 8 inches it is brown loam, and in the lower 6 inches it is brown very gravelly loam. The substratum consists of decomposed basalt and is 3 inches thick. It is underlain by hard bedrock.

Permeability of the Harahill soil is moderately slow. The root zone extends to a depth of 24 to 36 inches. The available water capacity is moderate. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

These soils are used for range, and they provide habitat for sage grouse, snowshoe rabbit, ground squirrel, and rockchuck.

The native vegetation on the Polecreek soil is low sagebrush, Sandberg bluegrass, and bluebunch wheatgrass. The native vegetation on the Harahill soil is big sagebrush, Idaho fescue, and bluebunch wheatgrass. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and sagebrush increases, and weeds and other undesirable annual plants become more abundant. Mechanical brush control and seeding are not practical on the Polecreek soil because of the stones and cobblestones in the surface layer. Mechanical seeding is practical in areas of the Harahill soil that are not too stony.

Slope, shrink-swell potential, and depth to bedrock are the main limitations to the use of these soils as sites for roads and buildings.

This complex is in capability subclass Vls, nonirrigated.

38-Polecreek-Manard complex, 0 to 30 percent slopes. This complex is on uplands and lava plains. The elevation ranges from 4,800 to 6,000 feet. The average annual precipitation is 14 inches, the average annual temperature is about 41 degrees F, and the frost-free period is 80 days.

The Polecreek soil makes up about 45 percent of the complex, and the Manard soil makes up about 35 percent. Areas of Harahill loam, Gaib very gravelly loam, Magic very stony silty clay, and Rock outcrop make up the rest.

The Polecreek soil is shallow and well drained. It formed in residuum of rhyolite or basalt. Typically, the

surface layer in the upper part is brown very gravelly loam 4 inches thick. In the lower part it is grayish brown very cobbly loam 5 inches thick. The subsoil is light brown very cobbly clay. Bedrock is at a depth of 18 inches.

Permeability of the Polecreek soil is slow. The root zone extends to a depth of about 10 to 20 inches. The available water capacity is low. Surface runoff is very slow to rapid, and the hazard of erosion is slight to high.

The Manard soil is moderately deep and well drained. It formed in residuum of basalt. Typically, the surface layer in the upper part is grayish brown very stony silt loam about 3 inches thick. In the lower part it is grayish brown very stony silty clay loam 6 inches thick. The subsoil is 17 inches thick. In the upper 9 inches it is pale brown silty clay loam that contains common bleached grains of sand and silt; and in the lower 8 inches, it is light yellowish brown silty clay. The substratum is a white, silica-cemented hardpan 2 inches thick. It is underlain by bedrock.

Permeability of the Manard soil is very slow. The root zone extends to a depth of 20 to 37 inches. The available water capacity is moderate. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate.

These soils provide habitat for sage grouse and mule deer.

The native vegetation on the Polecreek soil is mainly low sagebrush, bluebunch wheatgrass, and Sandberg bluegrass. The native vegetation on the Manard soil is mainly alkali sagebrush, Idaho fescue, and Sandberg bluegrass. Reseeding is limited by stoniness and by shallowness to the clayey subsoil.

Slope, depth to bedrock, and large stones are the main limitations to the use of these soils as sites for buildings and roads.

This complex is in capability subclass VIs, nonirrigated.

39-Polecreek-Rock outcrop complex, 0 to 30 percent slopes. This complex is on lava plains and hills. The elevation ranges from 4,800 to 6,500 feet. The average annual precipitation is 14 inches, the average annual temperature is about 40 degrees F, and the frost-free period is 80 days.

The Polecreek soil makes up about 65 percent of the complex, and Rock outcrop makes up about 20 percent. Areas of Gaib very gravelly loam, Magic very stony silty clay, and Manard very stony silt loam make up the rest.

The Polecreek soil is shallow and well drained. It formed in residuum of basalt and rhyolite. Typically, the surface layer in the upper part is brown very gravelly loam about 4 inches thick. In the lower part it is grayish brown very cobbly loam 5 inches thick. The subsoil is light brown very cobbly clay 9 inches thick. It is underlain by bedrock.

Permeability is slow. The root zone extends to a depth of 10 to 20 inches. The available water capacity is low. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

Rock outcrop consists of exposed basalt and rhyolite bedrock. In places, very shallow soil material covers the bedrock. This soil material supports little or no vegetation.

This complex is used for range, and it provides habitat for mule deer, cottontail rabbit, sage grouse, hawk, and falcon. The native vegetation is low sagebrush, bluebunch wheatgrass, and Sandberg bluegrass. Seeding is limited by Rock outcrop, stones, and shallowness to bedrock.

Slope, depth to bedrock, and large stones are the main limitations to the construction of buildings or roads.

This complex is in capability subclass VIs, nonirrigated.

40-Polecreek-Rock outcrop complex, 30 to 60 percent slopes. This complex is on lava plains and uplands. The elevation ranges from 4,800 to 6,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 40 degrees F, and the frost-free period is 80 days.

The Polecreek soil makes up about 60 percent of the complex, and Rock outcrop makes up about 20 percent. Areas of Gaib very gravelly loam, Winu stony loam, and Elkcreek loam make up the rest.

The Polecreek soil is shallow and well drained. It formed in residuum of basalt and rhyolite. Typically, the surface layer in the upper part is brown very gravelly loam 4 inches thick; and in the lower part it is grayish brown very cobbly loam 5 inches thick. The subsoil is light brown very cobbly clay 9 inches thick. It is underlain by bedrock.

Permeability is slow. The root zone extends to a depth of 10 to 20 inches. The available water capacity is low. Surface runoff is rapid to very rapid, and the hazard of erosion is high to very high.

Rock outcrop consists of exposed basalt and rhyolite bedrock. In places, very shallow soil material covers the bedrock. This soil material supports little or no vegetation.

This complex is used for range, and it provides habitat for mule deer, sage grouse, rabbit, hawk, and falcon. The native vegetation is mainly low sagebrush, bluebunch wheatgrass, and Sandberg bluegrass. Reseeding is limited by stoniness, Rock outcrop, and the shallowness to a heavy clay subsoil.

Slope, large stones, and depth to bedrock are the main limitations to the use of the soil as sites for buildings and roads.

This complex is in capability subclass VIIs, nonirrigated.

41-Rands loam, 0 to 4 percent slopes. This is a very deep, well drained soil that formed in mixed alluvium. It is on fans and terraces. The elevation ranges from 4,800 to 5,200 feet. The average annual precipitation is 13 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is brown loam about 17 inches thick. The subsoil is 24 inches thick. In the upper

11 inches, it is brown clay; in the middle 5 inches, it is brown clay loam; and in the lower 8 inches, it is reddish yellow, calcareous fine gravelly clay loam. The substratum is pink gravelly loamy sand and very pale brown gravelly loamy coarse sand to a depth of 60 inches or more.

Included in mapping are small areas of Brinegar loam, Simonton loam, and Vodermaier gravelly coarse sandy loam.

Permeability is slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is very slow to slow, and the hazard of erosion is slight to moderate.

About 70 percent of the acreage is cultivated cropland. The rest is rangeland and nonirrigated pasture.

In most years, there is sufficient moisture for annual cropping, and, in rotation, alfalfa is grown for 10 to 15 years and small grains are grown for 4 to 5 years. Some of the grain is grown in a crop-fallow system to control weeds. A considerable acreage of winter wheat can be ruined by flooding by snowmelt. Intermediate wheatgrass and pubescent wheatgrass are suitable for seeding pasture and waterways.

Stubble mulching, chiseling, and minimum tillage help to control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan and thereby improves aeration and promotes better penetration by roots and water.

The native vegetation on this soil is mainly alkali sagebrush, Sandberg bluegrass, and Idaho fescue. If the range deteriorates, the proportion of Idaho fescue decreases and the proportion of alkali sagebrush and forbs increases. Seeding is a suitable practice.

This soil provides habitat for ground squirrel and mourning dove. The rangeland provides habitat for sage grouse.

Low strength and high shrink-swell potential are the main limitations to the use of this soil as sites for buildings and roads.

This map unit is in capability subclass IIIe, irrigated, and IIc, nonirrigated.

42-Rands loam, 4 to 12 percent slopes. This is a very deep, well drained soil that formed in mixed alluvium. It is on high alluvial fans and terraces. The elevation ranges from 4,800 to 5,200 feet. The average annual precipitation is 13 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is brown loam about 17 inches thick. The subsoil is 24 inches thick. In the upper 11 inches it is brown clay; in the middle 5 inches it is brown clay loam; and in the lower 8 inches it is reddish yellow, calcareous fine gravelly clay loam. The substratum is pink gravelly loamy sand and very pale brown gravelly loamy coarse sand to a depth of 60 inches or more.

Included in mapping are small areas of Brinegar loam, Simonton loam, and Vodermaier gravelly coarse sandy loam.

Permeability is slow. The available water capacity is very high. The root zone extends to a depth of 60 inches or more. Surface runoff is medium or rapid, and the hazard of erosion is high or very high.

About 70 percent of the acreage is cultivated cropland. The rest is rangeland and dry pasture.

In most years, there is sufficient moisture for annual cropping, and, in rotation, alfalfa is grown for 10 to 15 years and small grains are grown for 4 or 5 years. A considerable acreage of winter wheat can be ruined by flooding by snowmelt. Some of the grain is grown in a crop-fallow system to control weeds. Intermediate wheatgrass and pubescent wheatgrass are suitable for seeding pasture and waterways.

Stubble mulching, chiseling, and minimum tillage help to control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan and thereby improves aeration and promotes better penetration by roots and water.

The native vegetation on this soil is mainly alkali sagebrush, Sandberg bluegrass, and Idaho fescue. If the range deteriorates, the proportion of Idaho fescue decreases, the proportion of alkali sagebrush and forbs increases, and weeds and other undesirable annual plants become more abundant.

This soil provides habitat for ground squirrel, mourning dove, and sage grouse.

Low strength, frost action, and high shrink-swell potential are the main limitations to the use of this soil as sites for buildings and roads.

This map unit is in capability subclass IVe, irrigated, and IIIe, nonirrigated.

43-Rands loam, 12 to 25 percent slopes. This is a very deep, well drained soil that formed in mixed alluvium. It is on alluvial fans and terraces. The elevation ranges from 4,800 to 6,000 feet. The average annual precipitation is 13 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is brown loam about 17 inches thick. The subsoil is 24 inches thick. In the upper 11 inches it is brown clay; in the middle 5 inches it is brown clay loam; and in the lower 8 inches it is reddish yellow, calcareous fine gravelly clay loam. The substratum is pink gravelly loamy sand and very pale brown gravelly loamy coarse sand to a depth of 60 inches or more.

Included in mapping are small areas of Brinegar loam, Simonton loam, and Vodermaier gravelly coarse sandy loam.

Permeability is slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is very rapid, and the hazard of erosion is very high.

This soil is used as rangeland, and it provides habitat for ground squirrel, mourning dove, sage grouse, mule deer, and antelope. The native vegetation is mainly Sandberg bluegrass, Idaho fescue, and alkali sagebrush. If the range deteriorates, the proportion of Idaho fescue decreases, and the proportion of alkali sagebrush and forbs increases. Seeding is a suitable practice on this soil.

Slope, shrink-swell potential, and low strength are the main limitations to the use of this soil as sites for buildings and roads.

This map unit is in capability subclass VIe, nonirrigated.

44-Rands-Simonton complex, 0 to 25 percent slopes. The soils in this complex formed in mixed alluvium on fans and terraces. The elevation ranges from 4,800 to 6,000 feet. The average annual precipitation is 13 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

The Rands soil makes up about 60 percent of the complex, and the Simonton soil makes up about 30 percent. Areas of Brinegar loam, 0 to 7 percent slopes, and a soil that is similar to the Simonton soil except that it has lime in the substratum make up the rest.

The Rands soil is very deep and well drained. Typically, the surface layer is brown loam about 17 inches thick. The subsoil is 24 inches thick. In the upper 11 inches it is brown clay; in the middle 5 inches it is brown clay loam; and in the lower 8 inches it is reddish yellow fine gravelly loam. The substratum is pink and very pale brown gravelly loamy sand to a depth of 60 inches.

Permeability of the Rands soil is slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

The Simonton soil is very deep and well drained. Typically, the surface layer is grayish brown loam 7 inches thick. The subsoil is 30 inches thick. In the upper part it is brown loam 3 inches thick; in the middle part it is pinkish gray loam 5 inches thick; and in the lower part it is light brown loam 22 inches thick. The substratum is light gray loamy sand to a depth of 60 inches or more.

Permeability of the Simonton soil is moderately slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is none to very rapid, and the hazard of erosion is none to very high.

This complex is used as rangeland, watershed, and habitat for ground squirrel, mourning dove, sage grouse, western meadowlark, mule deer, hawk, and falcon. The native vegetation on the Rands soil is mainly Idaho fescue, Sandberg bluegrass, and alkali sagebrush. The native vegetation on the Simonton soil is mainly Idaho fescue, bluebunch wheatgrass, and big sagebrush. If the range deteriorates, the proportion of sagebrush increases, the proportion of Idaho fescue and bluebunch wheatgrass decreases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice.

Slope, shrink-swell potential, and low strength are the major limitations to the use of these soils as sites for buildings.

This complex is in capability subclass VIe, nonirrigated.

45-Riceton coarse sandy loam, 0 to 4 percent slopes. This is a very deep and well drained soil that formed in alluvium that derived from acid igneous rocks. It is on fans and terraces. The elevation ranges from 4,900 to 5,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is grayish brown coarse sandy loam about 21 inches thick. The subsoil in the upper part is brown gravelly coarse sandy loam about 7 inches thick. In the lower part it is pale brown gravelly coarse sandy loam about 18 inches thick. The substratum in the upper part is pale brown gravelly coarse sandy loam about 8 inches thick; and in the lower part, to a depth of 70 inches, it is light colored sand and gravel.

Included in mapping are small areas of Brinegar loam, Brailsford loam, and Vodermaier gravelly coarse sandy loam.

Permeability is moderately rapid. The root zone extends to a depth of 60 inches or more. The available water capacity is high. Surface runoff is slow, and the hazard of erosion is slight to moderate.

More than 95 percent of the acreage is irrigated and dryfarmed cropland. The rest is rangeland and pasture.

In most years there is sufficient moisture for annual cropping, and, in rotation, small grains are grown for 4 to 5 years and alfalfa is grown for 10 to 15 years. Some of the grain is grown in a crop-fallow system to control weeds.

Stubble mulching, chiseling, weed control, and minimum tillage help to control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan and thereby improves aeration and promotes better penetration by roots and water. Waterways should be shaped and seeded to a perennial grass.

The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range deteriorates, the proportion of Idaho fescue and bluebunch wheatgrass decreases, the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice, and it can be done late in fall or early in spring.

Cultivated areas provide habitat for mourning dove and ground squirrel. Rangeland provides habitat for ground squirrel and snowshoe rabbit.

There are few limitations to the construction of buildings and roads.

This map unit is in capability subclass IIIe, irrigated, and IVs, nonirrigated.

46-Riceton coarse sandy loam, 4 to 12 percent slopes. This is a very deep, well drained soil that formed in alluvium that derived from acid igneous rock. It is on alluvial fans and stream terraces. The elevation ranges from 4,900 to 5,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is grayish brown coarse sandy loam about 21 inches thick. The subsoil in the upper part is brown gravelly coarse sandy loam 7 inches thick. In the lower part it is pale brown gravelly coarse sandy loam 18 inches thick. The substratum in the upper part is pale brown gravelly coarse sandy loam 8 inches thick. In the lower part, to a depth of 70 inches, it is light colored sand and gravel.

Included in mapping are small areas of Brinegar loam, Brailsford loam, and Vodermaier gravelly coarse sandy loam.

Permeability is moderately rapid. The root zone extends to a depth of 60 inches or more. The available water capacity is high. Surface runoff is medium, and the hazard of erosion is slight to moderate.

More than 95 percent of the acreage is irrigated or dryfarmed cropland. The rest is rangeland and pasture.

In most years there is sufficient moisture for annual cropping, and in rotation, small grains are grown for 4 to 5 years and alfalfa is grown for 10 to 15 years. Some of the grain is grown in a crop-fallow system to control weeds.

Stubble mulching, chiseling, weed control, and minimum tillage help to control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan and thereby improves aeration and promotes better penetration by roots and water. Chiseling across the slope or on the contour also reduces runoff. Waterways should be shaped and seeded to a perennial grass.

The native vegetation is mainly Idaho fescue, bluebunch wheatgrass, and big sagebrush. If the range deteriorates, the proportion of Idaho fescue and bluebunch wheatgrass decreases, the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice.

Cultivated areas provide habitat for mourning dove and ground squirrel. Rangeland provides suitable habitat for ground squirrel and snowshoe rabbit.

Slope is the major limitation to the use of this soil as sites for buildings, but the buildings can be designed to offset this limitation.

This map unit is in capability subclass IVe, nonirrigated, and lVe, irrigated.

47-Roanhide coarse sandy loam, 4 to 25 percent slopes. This is a moderately deep and well drained soil that formed in residuum of granite. It is on hills. The elevation ranges from 5,000 to 8,200 feet. The average annual precipitation is 14 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 75 days.

Typically, the surface layer is grayish brown coarse sandy loam about 9 inches thick. The subsoil is brown coarse sandy loam 6 inches thick. The substratum is light brownish gray coarse sandy loam 7 inches thick. It is underlain by bedrock.

Included in mapping are small areas of Bauscher loam, Earcree gravelly coarse sandy loam, and Rock outcrop.

Permeability is moderately rapid. The root zone extends to a depth of 20 to 40 inches. The available water capacity is low. Surface runoff is medium, and the hazard of erosion is slight to moderate.

This soil is used mainly for range, and it provides good habitat for ground squirrel, snowshoe rabbit, sage grouse, and mule deer.

The native vegetation on this soil consists mainly of big sagebrush, bluebunch wheatgrass, and Thurber needlegrass. If the range deteriorates, the proportion of bluebunch wheatgrass decreases, the proportion of big sagebrush and forbs increases, and weeds and other undesirable annual plants become more abundant. Good grazing management can maintain or improve the plant cover. This soil is suited to limited seeding.

Slope and depth to bedrock are the main limitations to the construction of buildings and roads.

This map unit is in capability subclass Vle, nonirrigated.

48-Roanhide coarse sandy loam, 25 to 60 percent slopes. This is a moderately deep, well drained soil that formed in residuum of granite. It is on mountains. The elevation ranges from 5,000 to 8,200 feet. The average annual precipitation is 14 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 75 days.

Typically, the surface layer is grayish brown coarse sandy loam about 9 inches thick. The subsoil is brown coarse sandy loam 6 inches thick. The substratum is light brownish gray coarse sandy loam 7 inches thick. It is underlain by bedrock.

Included in mapping are areas of Bauscher loam, Earcree gravelly coarse sandy loam, and Rock outcrop.

Permeability is moderately rapid. The root zone extends to a depth of 20 to 40 inches. The available water capacity is low. Surface runoff is rapid to very rapid, and the hazard of erosion is high.

This soil is used mainly for range, and it provides good habitat for ground squirrel, snowshoe rabbit, sage grouse, and mule deer.

The native vegetation on this soil consists mainly of bluebunch wheatgrass, Thurber needlegrass, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass decreases, the proportion of big sagebrush and forbs increases, and weeds and other undesirable annual plants become more abundant. Good grazing management can maintain or improve the plant cover. Seeding by conventional methods is limited by steep slopes and the high hazard of erosion.

Slope and depth to bedrock are the main limitations to the construction of buildings and roads.

This map unit is in capability subclass VIIe, nonirrigated.

49-Roanhide-Earcree complex, 25 to 60 percent slopes. This complex is on granitic hills and mountains. The elevation ranges from 5,200 to 8,200 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is 75 days.

The Roanhide soil makes up about 50 percent of the complex, and the Earcree soil makes up about 30 percent. Areas of Bauscher loam, areas of a soil that is similar to the Roanhide soil except that it is less than 20 inches deep to granite, and areas of Rock outcrop make up the rest.

The Roanhide soil is on south-facing side slopes. It is moderately deep and well drained. It formed in residuum of granite. Typically, the surface layer is grayish brown and brown coarse sandy loam about 9 inches thick. The subsoil is brown coarse sandy loam 6 inches thick. The substratum is light brownish gray coarse sandy loam 7 inches thick. It is underlain by bedrock.

Permeability of the Roanhide soil is moderately rapid. The root zone extends to a depth of 20 to 40 inches. The available water capacity is low to moderate. Surface runoff is medium to high, and the hazard of erosion is moderate to high.

The Earcree soil is on north-facing side slopes. It is deep and very deep and well drained. It formed in colluvium and alluvium that derived from granite and andesite. Typically, the surface layer is dark grayish brown and grayish brown gravelly coarse sandy loam about 33 inches thick. The underlying material in the upper 17 inches is light brownish gray gravelly loamy coarse sand; and below that, to a depth of 60 inches or more, it is light olive gray and light yellowish brown loamy coarse sand.

Permeability of the Earcree soil is moderately rapid. The root zone extends to a depth of 50 inches or more. The available water capacity is very high. Surface runoff is medium to rapid, and the hazard of erosion is very high.

These soils are used for range, and they provide habitat for ground squirrel, snowshoe rabbit, sage grouse, mule deer, coyote, falcon, and hawk.

The native vegetation on the Roanhide soil consists mainly of bluebunch wheatgrass, big sagebrush, and Thurber needlegrass. The native vegetation on the Earcree soil consists mainly of bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of big sagebrush and forbs increases, and weeds and other undesirable annual plants become more abundant. These soils are poorly suited to reseeding by conventional methods because of the steep slopes.

Slope and, in the Roanhide soil, depth to bedrock are the main limitations to the construction of buildings and roads.

This complex is in capability subclass VIe, nonirrigated.

50-Rock outcrop. This miscellaneous area consists of exposed basalt, rhyolite, andesite, and granite. Slopes are dominantly 20 to 75 percent. Crevices in the rock contain some soil material, and in some places, a few inches of soil material cover the bedrock. The vegetation is moss or lichens. Rock outcrop is mapped in complex with Gaib, Manard, Polecreek, Kevanton, and Elkcreek soils.

This miscellaneous area has scenic value and is used principally as watershed and as habitat for wildlife.

This miscellaneous area is in capability subclass VIIIs.

51-Simonton loam, 0 to 4 percent slopes. This is a very deep, well drained soil that formed in mixed alluvium. It is on alluvial fans and stream terraces. The elevation ranges from 4,800 to 5,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is grayish brown loam about 7 inches thick. The subsoil is 30 inches thick. In the upper 3 inches it is brown loam, in the middle 5 inches it is pinkish gray loam, and in the lower 22 inches it is light brown loam. The substratum is light gray loamy sand to a depth of 60 inches or more.

Included in mapping are small areas of Brinegar loam, Brailsford loam, Rands loam, Riceton coarse sandy loam, and Vodermaier gravelly coarse sandy loam.

Permeability is moderately slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is very slow to slow, and the hazard of erosion is none to slight.

More than 80 percent of the acreage is cultivated cropland. The rest is rangeland and pasture.

In most years there is sufficient moisture for annual cropping, and, in rotation, alfalfa is grown for 10 to 15 years and small grains are grown for 4 to 5 years. Some of the grain is grown in a crop-fallow system to control weeds. Intermediate wheatgrass and pubescent wheatgrass are suitable for seeding pasture and waterways.

Stubble mulching, chiseling, and minimum tillage help to control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan, and thereby improves aeration and promotes better penetration by roots and water.

The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice.

This soil is well suited to habitat for ground squirrel, mourning dove, and sage grouse. Ducks and geese feed on the grain stubble in fall.

Shrink-swell potential and frost action are the main limitations to the use of this soil as sites for buildings and roads. These structures can be designed to offset the limitations.

This map unit is in capability subclass IIIe, irrigated, and IIIc, nonirrigated.

52-Simonton loam, 4 to 12 percent slopes. This is a very deep, well drained soil that formed in mixed alluvium. It is on stream terraces and alluvial fans. The elevation ranges from 4,800 to 5,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is grayish brown loam about 7 inches thick. The subsoil is about 30 inches thick. In the upper 3 inches it is brown loam, in the middle 5 inches it is pinkish gray loam, and in the lower 22 inches it is light brown loam. The substratum is light gray loamy sand to a depth of 60 inches or more.

Included in mapping are areas of Brinegar loam, Brailsford loam, Rands loam, Riceton coarse sandy loam, and Vodermaier gravelly coarse sandy loam.

Permeability is moderately slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is medium, and the hazard of erosion is slight to moderate.

More than 70 percent of the acreage is cultivated cropland. The rest is rangeland and pasture.

In most years there is sufficient moisture for annual cropping, and, in rotation, alfalfa is grown for 10 to 15 years and small grains are grown for 4 or 5 years. Some of the grains are grown in a crop-fallow system because of the need to control weeds. Intermediate wheatgrass and pubescent wheatgrass are suitable for seeding pasture and waterways.

Stubble mulching, chiseling, and minimum tillage help control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan and thereby improves aeration and promotes better penetration by roots and water.

The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice.

This soil is well suited to habitat for ground squirrel, mourning dove, western meadowlark, killdeer, sage grouse, hawk, and falcon. Duck and geese feed on the grain stubble in the fall.

Shrink-swell potential and frost action are the main limitations to the use of this soil as sites for buildings and roads. These structures can be designed to offset the

This map unit is in capability subclass IVe, irrigated, and IIIe, nonirrigated.

53-Simonton loam, 12 to 25 percent slopes. This is a very deep, well drained soil that formed in mixed alluvium. It is on terraces and alluvial fans. The elevation ranges from 4,800 to 6,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is grayish brown loam about 7 inches thick. The subsoil is about 30 inches thick. In the upper 3 inches it is brown loam, in the middle 5 inches it is pinkish gray loam, and in the lower 22 inches it is light brown loam. The substratum is light gray loamy sand to a depth of 60 inches or more.

Included in mapping are small areas of Elkcreek loam and Rands loam.

Permeability is moderately slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is slow to rapid, and the hazard of erosion is slight to high.

This soil is used as rangeland, and it provides habitat for sage grouse, snowshoe rabbit, ground squirrel, mourning dove, western meadowlark, mule deer, hawk, and falcon.

The native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant.- Seeding is a suitable practice.

Slope is the main limitation to the use of this soil as sites for buildings.

This map unit is in capability subclass IVe, nonirrigated.

54-Strom loam, 0 to 4 percent slopes. This is a very deep, somewhat poorly drained soil that formed in mixed alluvium. It is on fans, bottom lands, and low stream terraces. The elevation ranges from 5,000 to 5,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is a dark gray loam about 11 inches thick. The subsurface layer is gray loam about 3 inches thick. The subsoil is about 27 inches thick. In the upper 11 inches it is dark gray clay loam, in the middle 8 inches it is gray loam, and in the lower 8 inches it is light brownish gray loam. The substratum is light gray sandy loam to a depth of 60 inches or more. Mottles are at a depth of 30 to 48 inches.

Included in mapping are small areas of Houk silty clay loam, Marshdale loam, and Brailsford loam.

Permeability is moderately slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is very slow to

slow, and the hazard of erosion is none to slight. The water table is at a depth of 20 to 30 inches in spring, and it is below a depth of 50 inches late in the summer and in fall.

About 80 percent of the acreage is cultivated cropland. The rest is nonirrigated pasture.

In most years there is sufficient moisture for annual cropping, and, in rotation, alfalfa is grown for 10 to 12 years and small grains are grown for 2 to 4 years. Some of the grain is grown in a crop-fallow rotation to control weeds. Reed canarygrass, timothy, and meadow foxtail are suitable for seeding pasture and waterways. Stubble mulching, weed control, minimum tillage, and chiseling help .control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan and thereby improves aeration and promotes better penetration by roots and water.

The native vegetation is mainly Nebraska sedge and tufted hairgrass. With good management, these plants will remain in the composition in desirable proportions. Seeding is a suitable practice.

This soil provides habitat for shore birds, sandhill crane, duck, and geese.

The high water table, stream overflow by snowmelt, frost action, and low strength are the main limitations to the use of this soil as sites for roads and buildings. Roads can be designed to offset the low strength and the high water table.

This map unit is in capability subclass IIIw, irrigated, and IIIw, nonirrigated.

55-Strom sandy clay loam, 0 to 4 percent slopes. This is a very deep, somewhat poorly drained soil that formed in mixed alluvium. It is on alluvial fans, bottom lands, and stream terraces. The elevation ranges from 5,000 to 5,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer is a dark gray sandy clay loam about 11 inches thick. The subsurface layer is gray sandy loam about 3 inches thick. The subsoil is about 27 inches thick. In the upper 11 inches it is dark gray clay loam, in the middle 8 inches it is gray clay loam, and in the lower 8 inches it is light brownish gray loam. The substratum is light gray sandy loam to a depth of about 62 inches or more.

Included in mapping are small areas of Houk silty clay loam, Marshdale loam, and Brailsford loam.

Permeability is moderately slow. The root zone extends to a depth of 60 inches or more. The available water capacity is very high. Surface runoff is very slow to slow, and the hazard of erosion is none to slight.

About 80 percent of the acreage is cropland. The rest is nonirrigated pasture.

In most years there is sufficient moisture for annual cropping, and, in rotation, alfalfa is grown for 10 to 12 years and small grains are grown for 2 to 4 years. Some of the grain is grown in a crop-fallow rotation because of the need to control weeds. Reed canarygrass, timothy, and meadow foxtail are suitable for seeding pasture and waterways. Stubble mulching, weed control, minimum tillage, and chiseling help to control erosion and produce a favorable growth of crops. Chiseling breaks up the plowpan and thereby improves aeration and promotes better penetration by roots and water.

The native vegetation is mainly Nebraska sedge and tufted hairgrass. With good management, these plants will remain in the composition in desirable proportions. Seeding is a suitable practice.

This soil provides habitat for shore birds, sandhill crane, duck, and geese.

The high water table, stream overflow by snowmelt, frost action, and low strength are the main limitations to the use of this soil as sites for roads and buildings. Roads can be designed to offset the low strength and the high water table.

This map unit is in capability subclass IIIw, irrigated, and IIIw, nonirrigated.

56-Vodermaier gravelly coarse sandy loam, 0 to 4 percent slopes. This is a very deep and somewhat excessively drained soil that formed in mixed alluvium. It is on stream terraces and alluvial fans at an elevation of 4,800 to 5,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is about 30 inches thick. In the upper 7 inches it is grayish brown gravelly coarse sandy loam, and in the lower 23 inches it is dark grayish brown gravelly loamy coarse sand. The underlying material in the upper 13 inches is grayish brown gravelly loamy coarse sand; and below that, to a depth of 60 inches or more, it is light yellowish brown very gravelly coarse sand.

Included in mapping are small areas of Brinegar loam, Little Wood very gravelly loam, Riceton coarse sandy loam, Simonton loam, and a soil that is similar to the Vodermaier soil but is very gravelly or extremely gravelly.

Permeability is rapid. The root zone extends to a depth of 60 inches or more. The available water capacity is moderate. Surface runoff is slow, and the hazard of erosion is slight.

About 75 percent of the acreage is dryfarmed cropland. The rest is dryland pasture and range.

Alfalfa hay and small grains are the chief crops. In rotation, alfalfa is grown for 10 to 15 years and small grains are grown for 4 or 5 years. The main limitation to maximum production is the moderate available water capacity. This soil is better suited to winter grains because it dries out rapidly late in spring. Smooth bromegrass and intermediate wheatgrass are suitable grasses for seeding pasture. Minimum tillage and the use of crop residue help control erosion and produce a favorable growth of crops.

The native vegetation is mainly bluebunch wheatgrass and big sagebrush. If the range deteriorates, the propor-

tion of bluebunch wheatgrass decreases, the proportion of big sagebrush and forbs increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice, but there is a chance of seeding failure because of drought. Late fall is usually the best time for seeding.

This soil provides habitat for mourning dove, ground squirrel, sage grouse, and mule deer.

There are few limitations to the use of this soil as sites for buildings. If this soil is used as sites for septic tank absorption fields, pollution of ground water by the effluent is a hazard because of the rapid permeability of the soil.

This map unit is in capability subclass IVs, nonirrigated, and IIIe, irrigated.

57-Vodermaier gravelly coarse sandy loam, 4 to 12 percent slopes. This is a very deep, somewhat excessively drained soil that formed in mixed alluvium. It is on stream terraces and alluvial fans. The elevation ranges from 4,800 to 5,500 feet. The average annual precipitation is 14 inches, the average annual temperature is 41 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is 31 inches thick. In the upper 7 inches it is grayish brown gravelly coarse sandy loam, and in the lower 23 inches it is dark grayish brown gravelly loamy coarse sand. The underlying material in the upper 13 inches is grayish brown gravelly loamy coarse sand; and below that, to a depth of 60 inches or more, it is light yellowish brown very gravelly coarse sand.

Included in mapping are small areas of Riceton sandy loam, Simonton loam, Brinegar loam, Vodermaier soils that are very gravelly and extremely gravelly, and a similar soil that has slopes of 12 to 20 percent.

Permeability is rapid. The root zone extends to a depth of 60 or more inches. The available water capacity is moderate. Surface runoff is medium, and the hazard of erosion is moderate.

About 75 percent of the acreage is dryfarmed cropland. The rest is dryland pasture and range.

Alfalfa hay and small grains are the chief crops. In rotation, alfalfa is grown for 10 to 15 years and small grains are grown for 4 to 5 years. The main limitation to maximum production is the moderate available water capacity. This soil is better suited to winter grain because it dries out rapidly late in spring. Pubescent wheatgrass and intermediate wheatgrass are suitable for seeding pasture.

The native vegetation is mainly bluebunch wheatgrass and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass decreases, the proportion of big sagebrush and forbs increases, and weeds and other undesirable annual plants become more abundant. Seeding is a suitable practice if the range is in poor condition. There is a chance of seeding failure because of drought. Late fall is usually the best time for seeding.

This soil provides habitat for mourning dove, ground squirrel, sage grouse, and mule deer.

Slope is the main limitation to the use of this soil as sites for buildings. If this soil is used as sites for septic tank absorption fields, the effluent may pollute ground water because of the rapid permeability of the soil.

This map unit is in capability subclass IVe, nonirrigated, and IVe, irrigated.

58-Winu stony loam, 20 to 30 percent slopes. This is a moderately deep, well drained soil that formed in residuum and colluvium that derived from rhyolite and basalt. It is on mountainsides. The elevation ranges from 5,000 to 6,800 feet. The average annual precipitation is 16 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 60 days.

Typically, the surface layer in the upper part is dark gray stony loam about 2 inches thick. In the lower part it is grayish brown gravelly loam 15 inches thick. The subsoil in the upper 9 inches is grayish brown and brown gravelly loam. In the lower 5 inches it is yellowish brown very gravelly loam. The substratum is yellowish brown very gravelly loam 3 inches thick. It is underlain by bedrock.

Included in mapping are small areas of Elkcreek loam, Gaib very gravelly loam, and Rock outcrop.

Permeability is moderately slow. The root zone extends to a depth of 24 to 40 inches. The available water capacity is moderate. Surface runoff is rapid, and the hazard of erosion is high.

This soil is used for range, and it provides habitat for ground squirrel, rockchuck, snowshoe rabbit, mule deer, elk, coyote, falcon, and hawk. The native vegetation is mainly bluebunch wheatgrass, basin wildrye, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass decreases, the proportion of big sagebrush and forbs increases, and weeds and other undesirable annual plants become more abundant. Mechanical seeding is limited by the surface stones.

Slope, depth to bedrock, and large stones are the main limitations to the use of this soil as sites for buildings.

This map unit is in capability subclass VIe, nonirrigated.

59-Winu stony loam, 30 to 60 percent slopes. This is a moderately deep, well drained soil that formed in residuum and colluvium that derived from rhyolite and basalt. It is on hills. The elevation ranges from 5,000 to 6,800 feet. The average annual precipitation is 16 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 60 days.

Typically, the surface layer in the upper part is dark gray stony loam 2 inches thick. In the lower part it is grayish brown gravelly loam 15 inches thick. The subsoil in the upper 9 inches is grayish brown and brown gravelly loam. In the lower 5 inches it is yellowish brown very gravelly loam. The substratum is yellowish brown very gravelly loam 3 inches thick. It is underlain by bedrock.

Included in mapping are small areas of Elkcreek loam, Gaib very gravelly loam, and Rock outcrop.

Permeability is moderately slow. The root zone extends to a depth of 24 to 40 inches. The available water capacity is moderate. Surface runoff is rapid to very rapid, and the hazard of erosion is high to very high.

This soil is used for range, and it provides habitat for snowshoe rabbit, mule deer, and elk.

The native vegetation is mainly bluebunch wheatgrass, basin wildrye, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass decreases, the proportion of big sagebrush and forbs increases, and weeds and other undesirable annual grasses become more abundant. Mechanical brush control and seeding by conventional methods are not practical because of the steep slopes.

Slope, large stones, and depth to bedrock are the main limitations to the use of this soil as sites for buildings and roads.

This map unit is in capability subclass VIIe, nonirrigated.

60-Wiriu-Gaib complex, 30 to 60 percent slopes. This complex is on uplands. The elevation ranges from 5,000 to 6,800 feet.

The Winu soil makes up about 50 percent of this complex, and the Gaib soil makes up 30 percent. Areas of Gaib very gravelly loam, Elkcreek loam, Polecreek very gravelly loam, and Rock outcrop make up the rest. The Winu soil is on north-facing slopes, and the Gaib soil is on south-facing slopes; however, it was not practical to map the soils separately at the scale of mapping that was used.

The Winu soil is moderately deep and well drained. It formed in residuum and colluvium that derived from rhyolite. The average annual precipitation is 16 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 60 days. Typically, the surface layer in the upper part is dark gray stony loam about 2 inches thick. In the lower part it is grayish brown gravelly loam about 15 inches thick. The subsoil in the upper 9 inches is grayish brown and brown gravelly loam. In the lower 5 inches it is yellowish brown very gravelly loam. The substratum is yellowish brown very gravelly loam 3 inches thick. It is underlain by bedrock.

Permeability of the Winu soil is moderately slow. The root zone extends to a depth of 24 to 40 inches. The available water capacity is moderate. Surface runoff is very rapid, and the hazard of erosion is high to very high.

The Gaib soil is shallow and well drained. It formed in residuum of rhyolite. The average annual precipitation is 14 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 80 days. Typically, the surface layer is grayish brown very gravelly loam about 4 inches thick. The subsoil in the upper part is brown very gravelly sandy clay loam 5 inches thick. In the lower part it is brown very gravelly clay loam. It is underlain by bedrock.

Permeability of the Gaib soil is moderately slow. The root zone extends to a depth of 10 to 20 inches. The available water capacity is very low. Surface runoff is very rapid, and the hazard of erosion is high to very high.

This complex is used for range, and it provides habitat for ground squirrel, rockchuck, rabbit, sage grouse, mule deer, elk, coyote, hawk, and falcon. The native vegetation on the Winu soil is mainly bluebunch wheatgrass, basin wildrye, and big sagebrush. The native vegetation on the Gaib soil is mainly bluebunch wheatgrass and low sagebrush.

If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases, the proportion of forbs and sagebrush increases, and weeds and other undesirable annual plants become more abundant. Mechanical brush control and seeding by conventional methods are not practical because of the steepness of slope.

Slope, stones, and depth to rock are the major limitations to the use of these soils as sites for buildings and roads.

This complex is in capability subclass VIIs, nonirrigated.

61-Winu-Rock outcrop complex, 30 to 60 percent slopes. This complex is on rhyolite hills and mountains. The elevation ranges from 5,000 to 6,800 feet. The average annual precipitation is 16 inches, the average annual temperature is 40 degrees F, and the frost-free period is about 60 days.

The Winu soil makes up 70 percent of the complex, and Rock outcrop makes up 20 percent. Areas of Elkcreek loam, Gaib very gravelly loam, and Polecreek very gravelly loam make up the rest.

Winu soils are moderately deep and well drained. They formed in residuum and colluvium that derived from rhyolite and basalt. Typically, the surface layer in the upper part is dark gray stony loam about 2 inches thick. In the lower part it is grayish brown gravelly loam 15 inches thick. The subsoil in the upper 9 inches is grayish brown and brown gravelly loam. In the lower 5 inches it is yellowish brown very gravelly loam. The substratum is yellowish brown very gravelly loam 3 inches thick. It is underlain by bedrock.

Permeability is moderately slow. The root zone extends to a depth of 24 to 40 inches. The available water capacity is moderate. Surface runoff is very rapid, and the hazard of erosion is high to very high.

Rock outcrop consists of exposed basalt and rhyolite bedrock. In places, very shallow soil material covers the bedrock. This soil material supports little or no vegetation.

This complex is used for range, and it provides habitat for ground squirrel, rockchuck, rabbit, sage grouse, mule deer, elk, coyote, hawk, and falcon. The native vegetation is mainly bluebunch wheatgrass, basin wildrye, and big sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass and Idaho fescue decreases,

the proportion of forbs and big sagebrush increases, and weeds and other undesirable annual plants become more abundant. Mechanical brush control and seeding are not practical because of the steepness of slope and the Rock outcrop.

Slope, stones, and depth to bedrock are the main limitations to the use of the soil as sites for buildings and roads. Rock outcrop is an additional limitation to this use.

This complex is in capability subclass Vlls, nonirrigated.

62-Yutrue stony clay, 0 to 12 percent slopes. This is a deep and very deep, well drained soil that formed in alluvium and residuum of basalt. It is on lava plains. The elevation ranges from 4,750 to 5,000 feet. The average annual precipitation is 14 inches, the average annual temperature is 47 degrees F, and the frost-free period is about 80 days.

Typically, the surface layer in the upper part is light brownish gray stony clay about 2 inches thick. In the lower part it is light brownish gray clay 24 inches thick. The subsoil is pale brown silty clay loam and silt loam to a depth of 60 or more inches.

Included in mapping are small areas of a soil that is similar to the Yutrue soil but is less than 40 inches deep to bedrock. Also included are small areas of Bostrum gravelly silt loam and of Rock outcrop.

Permeability is very slow. The root zone extends to a depth of 40 to 60 inches or more. The available water capacity is high. Surface runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used for range, and it provides habitat for elk, mule deer, pronghorn, sage grouse, rabbit, rockchuck, coyote, and eagle. The native vegetation is mainly low sagebrush, Sandberg bluegrass, Idaho fescue, and narrowleaf pussytoes. Big sagebrush is in some areas. If the range deteriorates, the proportion of Idaho fescue decreases, the proportion of forbs and alkali sagebrush increases, and weeds and other undesirable annual plants become more abundant.. The stony surface layer is a limitation to mechanical seeding.

Shrink-swell potential, low strength, and large stones on the surface are the main limitations to the use of this soil as sites for buildings and roads.

This map unit is in capability subclass IIIe, nonirrigated.

Use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, and trees and shrubs.

Crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1967 there was 124,323 acres of cropland and pasture in the survey area (7). Of this, 81,018 acres was used for hay and pasture in rotation, 34,205 acres was used for wheat and barley, 4,100 acres was used for hay, and 5,000 acres was in summer fallow.

In 1967, there was 9,700 acres of irrigated land in the survey area; in 1975 there was about 15,000 acres.

Certain management practices apply to all the dryland soils in the survey area. All crops respond to applications of sulfur. Legumes benefit from inoculation with nitrogen fixation bacteria. Alfalfa hay, which is grown on all the soils that are farmed, responds to applications of fertilizer containing phosphorus and sulfur.

Regar bromegrass, manchar smooth brome, reed canarygrass, and Garrison creeping meadow foxtail are the

main grasses in the survey area. They respond to applications of nitrogen and sulfur.

Most medium-textured soils can be cropped annually (3). The crops can tolerate gravel in the soil if there is not enough to restrict the development of roots and the movement of water. Coarse-textured soils, if cropped annually, produce poor yields of wheat and barley because they have a low available water capacity. Weeds must be controllable without fallow if a soil is to be cropped every year.

Wheat and barley grown annually on a properly fertilized soil yield as well as if grown after fallow on a nonfertilized soil, or better. Successful annual cropping requires selecting suitable soils, controlling weeds, and applying sufficient nitrogen and sulfur. In general, annual cropping conserves soil.

Grass and potatoes for seed are being considered for production as cash crops in this survey area. Potatoes grow best in the coarser textured soils.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management (6). The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use. There are none in this survey area.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices. There are none in this survey area.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w,* s, or c, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w, s, or c because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Soil maps for detailed planning."

Rangeland

Glen M. Secrist, area range conservationist, and Robert J. Baum, state range conservationist, helped write this section.

About 63 percent of the survey area is rangeland; and about one-third of the average farm income is derived from the sale of livestock, principally cattle, which graze this rangeland. Sheep also graze the rangeland; but for the past ten years, the number of sheep has declined and the number of cattle has increased. Livestock graze the rangeland in this survey area late in spring, in summer, and in fall. Many of the stockmen move their livestock to rangeland at the lower elevations in adjacent counties for the relatively long, cold, snowy winters.

Where climate and topography are about the same, differences in the kind and amount of vegetation that rangeland can produce are related closely to the kind of soil. Effective management is based on the relationships among soils, vegetation, and water.

Most of the soils in the northern part of the survey area are steep loams that are shallow to moderately deep. The annual precipitation is about 18 inches in this part of the survey area, and the deeper soils support good vegetative cover.

The soils in the south-central and east-central parts of the survey area are nearly level to gently sloping and moderately deep. The surface layer is primarily loam or silt loam, and the subsoil is heavy and clayey. These soils receive about 12 inches of precipitation annually. Because the plants cannot extract moisture from the clayey subsoil during dry periods, the potential productivity is considerably lower for the soils in these parts of the survey area than it is for the soils in the northern part.

Most of the soils in the southern part of the survey area are loams that are shallow to moderately deep to bedrock. They have higher potential productivity than the soils in the central part of the survey area because they receive slightly more precipitation (14 inches) and because they do not have a heavy, clayey subsoil.

Some rangeland has deteriorated as a result of continued excessive use and repeated burning. Big sagebrush has increased, and annual weeds and grasses have invaded the deteriorated rangeland. The use of planned grazing systems and range seeding can improve the condition of the rangeland.

Table 7 shows, for each soil in the survey area, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 7 follows.

A range site is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation-the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil-is listed by common name. Under *composition,* the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service.

Recreation

About 60 percent of the survey area can be used for recreation (3).

Twin Lakes Reservoir is the principal site for boating, fishing, and water skiing. It contains 33,000 acre-feet of water and has approximately 15 miles of shoreline. Magic Reservoir is another excellent site for water sports. It contains 190,000 acre-feet of water and has more than 25 miles of shoreline.

Soldier Mountain, in the Sawtooth National Forest, is a center for skiing and other winter sports.

Elk, mule deer, cougar, and other big game attract hunters.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and

other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating *of fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally estab lished grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountainmahogany, bitterbrush, snowberry, and big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for open/and wildlife consists of cropland, pas ture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of de ciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, elk, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, sage grouse, meadowlark, and lark bunting.

The availability of winter forage controls the size of deer and elk herds (3). In winter, most of the deer migrate from the northern mountains to the southern foothills and the desert, where conditions are not as severe.

Blue grouse, ruffed grouse, and Franklin grouse nest in forests. They are commonly seen along mountain streams late in summer and early in fall. Sage grouse predominate in an area of sagebrush along the foothills and on Camas Prairie. They prefer patches of sagebrush two to three feet high.

Mourning dove nest on the prairie. Chukar, Hungarian partridge, and mountain quail nest in the southern foothills.

Canadian geese and duck-mainly teal, mallard, and pintail-breed in the wetlands. Migrating waterfowl rest and feed in the vicinity of Twin Lakes Reservoir and in the swamp south of Hill City.

Sandhill crane, curlew, bittern, swan, snow goose, sparrow hawk, vulture, mountain bluebird, robin, meadowlark, burrow owl, barn owl, and goldfinch also nest in the survey area.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building site development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They

have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill-trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material

during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of these materials. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely.

The ratings in table 13 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 15.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water management

Table 14 gives information on the soil properties and site features that affect water management.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering properties

Table 15 gives estimates of the engineering classification and of the range of properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in

diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (2) and the system adopted by the American Association of State Highway and Transportation Officials (1).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dryweight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indi cate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and chemical properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1 /3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low,* a change of less than 3 percent; *moderate,* 3 to 6 percent; and *high,* more than 6 percent. *Very high,* greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and water features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of

deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 17 gives the frequency of flooding and the time of year when flooding is most likely.

Frequency and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Only saturated zones within a depth of about 6 feet are indicated.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either rippable or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Cemented pans are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty in excavation. Pans are classified as rippable or hard. The pans in this survey area are hard. A hard pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (8). Beginning

with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 18, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol.* An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Xeroll *(Xer,* meaning dry, plus *oll,* from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argixerolls *(Argi,* meaning clay, plus *xeroll,* the suborder of the Mollisols that have a dry moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argixerolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, frigid, Typic Argixerolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil series and morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (5). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (8). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Soil maps for detailed planning."

Bauscher series

The Bauscher series consists of very deep, well drained soils that formed in material that weathered from granite. Bauscher soils are on alluvial fans and hills and have slopes of 0 to 25 percent. The average annual precipitation is 14 inches, and the average annual temperature is 41 degrees F.

Bauscher soils are similar to Brinegar and Harahill soils, and they are near Earcree, Riceton, and Roanhide soils. Unlike Bauscher soils, Brinegar soils are moderately well drained. Harahill soils are 24 to 36 inches deep to bedrock. Earcree and Riceton soils do not have a Bt horizon. Roanhide soils do not have a Bt horizon and are 20 to 40 inches deep to bedrock.

Typical profile of Bauscher loam, 0 to 12 percent slopes, about 3 miles north and 1.5 miles west of Hill City, 2,300 feet east and 200 feet south of the NW corner of sec. 18, T. 1 S., R. 12 E.

A11-0 to 7 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many very fine interstitial pores; slightly acid (pH 6.1); clear smooth boundary.

A12-7 to 14 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium and common coarse roots; many fine and medium pores; slightly acid (pH 6.2); clear wavy boundary.

B21t-14 to 24 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium and fine angular blocky; hard, friable, slightly sticky and slightly plastic; many very fine and fine and common

medium tubular pores; few thin clay films on faces of peds; slightly acid (pH 6.2); clear wavy boundary.

B22t-24 to 36 inches; pale brown (10YR 6/3) loam, dark brown (7.5YR 4/4) moist; weak coarse prismatic structure parting to moderate medium and coarse angular blocky; hard, friable, sticky and plastic; common very fine and fine and few medium roots; many very fine and fine tubular pores; many thin clay films on faces of peds; slightly acid (pH 6.1); clear wavy boundary.

B3t-36 to 49 inches; light yellowish brown (10YR 6/4) coarse sandy loam, dark brown (7.5YR 4/4) moist; weak very coarse prismatic structure parting to moderate medium angular blocky; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine and fine tubular pores; few thin clay films on faces of peds; slightly acid (pH 6.3); clear wavy boundary.

C-49 to 62 inches; pale brown (10YR 6/3) coarse sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine and medium roots; many very fine and fine tubular pores; slightly acid (pH 6.5).

The solum is 32 to 55 inches thick. The mollic epipedon is 20 to 30 inches thick, and it may include the upper part of the argillic horizon. The profile is micaceous throughout. Reaction is medium acid to neutral. The soil has a base saturation of 50 to 75 percent in some part above a depth of 75 centimeters.

The A1 horizon has value of 4 or 5, dry, and 2 or 3, moist, and chroma of 2 or 3, moist and dry.

The B2t horizon has hue of 10YR or 7.5YR; value of 4 through 6, dry, and 3 or 4, moist; and chroma of 3 or 4, moist and dry. The brighter colors occur in the lower part of the horizon. The texture is loam, sandy clay loam, or fine gravelly sandy clay loam.

The C horizon has value of 6 or 7, dry, and 4 or 5, moist, and chroma of 3 or 4, moist and dry.

Bostrum series

The Bostrum series consists of moderately deep, well drained soils that formed in material that weathered from basalt. Bostrum soils are on lava plains and have slopes of 0 to 20 percent. The average annual precipitation is 14 inches, and the average annual temperature is 47 degrees F.

Bostrum soils are similar to the Manard soils, and they are near Yutrue soils. Unlike Bostrum soils, Manard soils have a frigid soil temperature. Yutrue soils are deeper than 40 inches to bedrock, and they have a clayey A horizon.

Typical profile of Bostrum gravelly silt loam, 0 to 20 percent slopes, about 2.5 miles south of Magic Reservoir Dam; 150 feet east and 2,100 feet south of the NE corner of sec. 25, T. 2 S., R. 17 E.

A1-0 to 5 inches; light brownish gray (10YR 6/2) gravelly silt loam, dark grayish brown (10YR 4/2) moist; moderate medium platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many medium vesicular pores; 25 percent pebbles on surface; neutral (pH 6.8); abrupt smooth boundary.

A2-5 to 8 inches; light gray (10YR 7/1) silt loam; dark grayish brown (10YR 4/2) moist; strong fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many very fine tubular pores; neutral (pH 7.2); abrupt smooth boundary.

B21t-8 to 13 inches; brown (10YR 5/3) silty clay, brown (10YR 4/3) moist; strong fine and medium columnar structure that parts to strong medium angular blocky; very hard, firm, very sticky and very plastic; common fine roots; common very fine tubular pores; continuous thick dark yellowish brown (10YR 3/4) clay films on faces of peds and lining the pores; continuous thick bleached white (N 8/0) silt capping on top of columns; mildly alkaline (pH 7.6); clear smooth boundary.

B22t-13 to 19 inches; brown (10YR 5/3) silty clay, brown (10YR 4/3) moist; moderate medium prismatic structure that parts to strong fine and medium angular blocky; hard, firm, very sticky and very plastic; common fine roots; common very fine tubular pores; many moderately thick clay films on faces of peds and lining the pores; mildly alkaline (pH 7.8); clear smooth boundary.

B23t-19 to 29 inches; light yellowish brown (10YR 6/4) silty clay loam, brown (7.5YR 4/4) moist; strong fine and medium angular blocky structure; hard, firm, very sticky and very plastic; common fine roots; common very fine tubular pores; many moderately thick clay films on faces of peds and lining the pores; moderately alkaline (pH 8.2); abrupt wavy boundary.

R-29 inches; basalt; lime-coated surface.

Bedrock is at a depth of 20 to 40 inches. The solum is 20 to 34 inches thick. Gravel, cobblestones, and stones cover 0 to 30 percent of the surface.

The A horizon has value of 6 or 7, dry, and 3 or 4, moist, and chroma of 1 through 3, dry and moist. It is stony or gravelly silt loam.

The Bt horizon has hue of 10YR through 5YR; value of 4 through 6, dry, and 3 or 4, moist; and chroma of 3 or 4, moist and dry. The texture is silty clay, clay, clay loam, or silty clay loam.

Brailsford series

The Brailsford series consists of very deep, somewhat poorly drained soils that formed in mixed alluvium that derived mainly from acid igneous rock. Brailsford soils are in depressions on alluvial fans and stream terraces

and have slopes of 0 to 2 percent. The average annual precipitation is 14 inches, and the average annual temperature is 41 degrees F.

Brailsford soils are near Brinegar, Riceton, Simonton, and Strom soils, which, unlike Brailsford soils, have a mollic epipedon.

Typical profile of Brailsford loam about 2 miles east and 1 mile north of Corral; 2,290 feet west and 50 feet south of the NE corner of sec. 9, T. 1 S., R. 13 E.

Ap-0 to 8 inches; gray (10YR 6/1) loam, dark gray (10YR 4/1) moist; weak thin platy structure that parts to weak fine granular; hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; many fine interstitial pores; neutral (pH 7.2); clear smooth boundary.

A2-8 to 12 inches; gray (10YR 6/1) loam, dark gray (10YR 4/1) moist; moderate thin platy structure that parts to moderate fine granular; hard, friable, slightly sticky and slightly plastic; few fine and medium roots; many fine tubular pores; neutral (pH 7.2); abrupt smooth boundary.

B21t-12 to 16 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; dark brown (10YR 4/3) organic stains on vertical faces of peds; strong coarse columnar structure that parts to moderate medium angular blocky; very hard, very firm, sticky and plastic; common fine roots on vertical faces of peds; many fine tubular pores; thin continuous clay films on faces of peds; thick capping of light gray (10YR 6/1) uncoated silt grains; moderately alkaline (pH 8.0); abrupt wavy boundary.

B22t-16 to 30 inches; light brownish gray (2.5Y 6/2) sandy clay loam, brown (10YR 5/3) moist; dark brown (10YR 4/3) organic stains on vertical faces of peds; moderate medium prismatic structure that parts to moderate medium angular blocky; hard, firm, sticky and plastic; few fine roots; many fine tubular pores; thin nearly continuous clay films on faces of peds; moderately alkaline (pH 8.2); gradual wavy boundary.

B3tg-30 to 39 inches; light brownish gray (2.5Y 6/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; few fine distinct mottles that are light olive brown (2.5Y 5/4) and olive brown (2.5Y 4/4) moist; weak medium prismatic structure that parts to moderate fine and medium subangular blocky; slightly hard, friable, sticky and plastic; few fine roots; many fine and medium tubular pores; thin patchy clay films on faces of peds; very slightly calcareous matrix, moderately calcareous shot that are 2 to 5 millimeters in diameter; strongly alkaline (pH 8.8); clear wavy boundary.

C1g-39 to 45 inches; light brownish gray (2.5Y 6/2) fine gravelly sandy clay loam, light olive brown (2.5Y 5/4) moist; many fine prominent mottles that are greenish gray (5G 5/1) and bluish gray (5B 5/1) moist; moderate medium and coarse subangular blocky structure; hard, firm, sticky and plastic; moderately alkaline (pH 8.4); abrupt wavy boundary.

IIC2-45 to 60 inches; light gray (10YR 7/2) sand, pale brown (10YR 6/3) moist; single grained; loose; mildly alkaline (pH 7.6).

The water table fluctuates between depths of 30 and 40 inches, especially in spring. The solum is 30 to 45 inches thick. Coarse fragments make up 0 to 10 percent of the solum. Reaction ranges from neutral to strongly alkaline.

The A1 horizon has hue of 10YR or 2.5Y; value of 6 or 7, dry, and 4 or 5, moist; and chroma of 2 or less. The texture is loam or sandy loam.

The B2t horizon has hue of 10YR or 2.5Y; value of 6 or 7, dry, and 3 through 5, moist; and chroma of 2 or 3. It is sandy clay loam or clay loam. Mottles are at a depth of 30 to 40 inches.

The C horizon has hue of 10YR or 2.5Y, value of 6 or 7, dry, and 5 or 6, moist, and chroma of 2 through 4. Sand is at a depth of 40 to 60 inches.

Brailsford Variant

The Brailsford Variant consists of very deep, somewhat poorly drained soils that formed in mixed alluvium that weathered from basalt, granite, and rhyolite. These soils are in slight depressions on low stream terraces and have slopes of 0 to 2 percent. The average annual precipitation is 14 inches, and the average annual temperature is 41 degrees F.

Brailsford Variant soils are near Houk and Strom soils. Unlike the Brailsford Variant soils, the Houk and Strom soils have a mollic epipedon and do not have a high sodium content.

Typical profile of the Brailsford Variant loam about 0.75 mile south of Hill City; 425 feet west and 485 feet north of the SE corner of sec. 32, T. 1 S., R. 12 E.

A2-0 to 3 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure; hard, friable, slightly sticky and slightly plastic; many fine roots; common fine pores; moderately calcareous; strongly alkaline (pH 8.6); abrupt wavy boundary.

B21t-3 to 15 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure that parts to moderate fine and medium angular blocky; hard, firm, sticky and plastic; many fine roots; common fine pores; moderately thick continuous clay films on faces of peds; noncalcareous except for pockets of common lime nodules that are 2 millimeters in diameter; very strongly alkaline (pH 9.4); clear wavy boundary.

B22t-15 to 21 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; moderate medium prismatic structure that parts to moderate fine subangular blocky; hard, firm, sticky and plastic;

common fine roots; common fine pores; moderately thick continuous clay films on faces of peds; slightly calcareous; very strongly alkaline (pH 9.4); clear wavy boundary.

C1ca-21 to 38 inches; light gray (10YR 7/2) clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable, sticky and plastic; common very fine roots; few very fine pores; moderately calcareous; very strongly alkaline (pH 9.4); clear wavy boundary.

C2ca-38 to 42 inches; very pale brown (10YR 7/3) fine gravelly clay loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; many fine pores; moderately calcareous lime veins, and the matrix is slightly calcareous; few black concretions (effervesces slightly with 20 percent hydrogen peroxide) 2 millimeters in diameter; strongly alkaline (pH 8.8); clear wavy boundary.

C3-42 to 49 inches; very pale brown (10YR 7/3) fine gravelly loam; yellowish brown (10YR 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; very few roots; common black concretions, 2 to 5 millimeters in diameter, that increase to many in the lower part (effervesces moderately with 20 percent hydrogen peroxide); 25 percent fine angular gravel; slightly calcareous; strongly alkaline (pH 8.8); abrupt smooth boundary.

C4cn-49 to 50 inches; very dark gray (N 3/0) manganese oxide pan, weakly iron-cemented; black (N 2/0) moist; moderate thin platy structure; very hard, very firm; effervesces strongly with 20 percent hydrogen peroxide; moderately alkaline (pH 8.1); abrupt smooth boundary.

C5g-50 to 60 inches; gray (5Y 6/1) sandy clay loam; common medium faint mottles that are pale olive (5Y 6/3) and light olive gray (5Y 6/2), dry, and dark greenish gray (5G 4/1, 5BG 4/1) and dark bluish gray (5B 4/1), moist; massive; hard, firm, sticky and plastic; moderately alkaline (pH 8.2).

The water table fluctuates between depths of 36 and 60 inches. The solum is 17 to 26 inches thick. Most pedons have a thin manganese pan, less than 2 inches thick, at a depth of 40 to 65 inches. Reaction of the solum is strongly to very strongly alkaline.

The A2 horizon has hue of 2.5Y or 10YR; value of 6 or 7, dry, and 4 or 5, moist; and chroma of 1 or 2, moist and dry. It is commonly loam, but in some pedons it is coarse sandy loam or clay loam.

The B2t horizon has hue of 2.5Y or 10YR; value of 6 or 7, dry, and 4 or 5; moist; and chroma of 2 or 3. It is loam, sandy clay loam, or clay loam.

The C horizon is moderately calcareous to noncalcareous, and it is stratified below a depth of about 38 inches.

Brinegar series

The Brinegar series consists of very deep, moderately well drained soils that formed in mixed alluvium that derived from acidic and basic igneous rock and some sedimentary rock. These soils are on alluvial fans and terraces and have slopes of 0 to 7 percent. The average annual precipitation is 14 inches, and the average annual temperature is 41 degrees F.

Brinegar soils are similar to the Bauscher soils. They are near Brailsford, Marshdale, Riceton, Simonton, and Strom soils. Unlike Brinegar soils, Bauscher soils are not saturated with water early in spring, and they do not contain mottles above a depth of 40 inches. Bauscher, Riceton, and Simonton soils are well drained. Brailsford soils are ochric, and they are somewhat poorly drained. Marshdale soils are poorly drained, and Strom soils are somewhat poorly drained.

Typical profile of Brinegar loam, 0 to 1 percent slopes, about 2 miles north of Hill City; 2,500 feet west and 1,100 feet south of the NE corner of sec. 17, T. 1 S., R. 12 E.

Ap-0 to 8 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine tubular pores; slightly acid (pH 6.1); clear smooth boundary.

A12-8 to 14 inches; dark gray (10YR 4/1) loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; common very fine and fine roots; many fine tubular pores; 10 percent fine gravel; slightly acid (pH 6.2); clear wavy boundary.

B1t-14 to 20 inches; gray (10YR 5/1) loam, very dark brown (10YR 2/2) broken and dark brown (10YR 3/3) rubbed moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common very fine and fine roots; many fine tubular pores; few thin clay films on faces of peds and in pores; 15 percent fine gravel; slightly acid (pH 6.2); clear wavy boundary.

B21t-20 to 23 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common very fine and fine roots; many fine tubular pores; few thin clay films on faces of peds and in pores; slightly acid (pH 6.2); clear wavy boundary.

B22t-23 to 33 inches; pale brown (10YR 6/3) clay loam, brown (7.5YR 4/4) moist; moderate fine and medium prismatic structure that parts to moderate medium angular blocky; very hard, very firm, sticky and plastic; many fine roots between peds; many fine and few medium tubular pores; continuous moderately thick clay films on faces of peds and in pores; slightly acid (pH 6.4); clear wavy boundary.

C1-33 to 40 inches; light brown (7.5YR 6/4) coarse sandy loam, brown (7.5YR 5/4) moist; common fine and medium distinct strong brown (7.5YR 5/6) mottles; massive; soft, very friable; few very fine and fine roots; many fine tubular pores; slightly acid (pH 6.4); clear wavy boundary.

C2-40 to 49 inches; light brown (7.5YR 6/4) gravelly coarse sand, brown (7.5YR 5/4) moist; single grained; loose; few very fine and fine roots; many fine tubular pores; slightly acid (pH 6.5); clear wavy boundary.

C3-49 to 52 inches; reddish brown (2.5YR 5/4) gravelly coarse sand, reddish brown (2.5YR 5/4) moist; discontinuous manganese layer that is black (N 2/0) dry and moist; massive; slightly hard, firm; few fine tubular pores; slightly acid (pH 6.5); abrupt discontinuous boundary.

C4-52 to 60 inches; very pale brown (10YR 7/4) gravelly coarse sand, yellowish brown (10YR 5/4) moist; many medium and large prominent yellowish red (5YR 4/8) mottles; single grained; loose; many fine tubular pores; slightly acid (pH 6.5).

The solum is 27 to 35 inches thick. The mollic epipedon is 20 to 27 inches thick and may include the B1 horizon. The soil is slightly acid to neutral. It has a base saturation of 50 to 75 percent in some part above a depth of 75 centimeters. Most pedons have fine angular gravel throughout.

The Ap horizon is loam and coarse sandy loam. It has hue of 10YR or 7.5YR; value of 3 or 4, dry, and 2 or 3, moist; and chroma of 1 or 2.

The B2t horizon is clay loam, sandy clay loam, gravelly clay loam, and loam. It has value of 4 through 6, dry, and 2 through 4, moist, and chroma of 2 through 4. The C horizon is gravelly sandy loam, gravelly loam, or gravelly coarse sandy loam. Mottling begins at a depth of 30 to 48 inches. The water table is at a depth of 36 inches early in spring and at a depth of 5 feet late in summer.

Earcree series

The Earcree series consists of deep and very deep, well drained soils that formed in material that weathered from granite or andesite. Earcree soils are on uplands. The slopes are 5 to 60 percent. The average annual precipitation is 18 inches, and the average annual temperature is 39 degrees F.

Earcree soils are similar to Lockman soils and are near Bauscher, Lockman, Riceton, and Roanhide soils. Unlike Earcree soils, Bauscher soils have a B2t horizon. Lockman soils have an organic horizon and a thinner mollic epipedon. Riceton soils are on alluvial fans; their mean soil temperature in summer is higher than 59 degrees F. Roanhide soils are 20 to 40 inches deep to bedrock.

Typical profile of Earcree gravelly coarse sandy loam, 25 to 60 percent slopes, 7 miles north and 1 mile east of Hill City; 260 feet east and 200 feet north of the SW corner of sec. 22, T. 1 N, R. 12 E.

A11-0 to 6 inches; dark grayish brown (10YR 4/2) gravelly coarse sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; many very fine and fine roots; many fine interstitial pores; medium acid (pH 6.0); clear smooth boundary.

A12-6 to 20 inches; dark grayish brown (10YR 4/2) gravelly coarse sandy loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable; many very fine and fine roots; many fine tubular pores; slightly acid (pH 6.2); clear smooth boundary.

A13-20 to 28 inches; dark grayish brown (10YR 4/2) gravelly coarse sandy loam, very dark brown (10YR 2/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable; common very fine and fine roots; many fine tubular pores; slightly acid (pH 6.4); clear wavy boundary.

A14-28 to 33 inches; grayish brown (10YR 5/2) gravelly coarse sandy loam, very dark brown (10YR 2/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable; many very fine and fine roots; many fine tubular pores; slightly acid (pH 6.5); abrupt wavy boundary.

C1-33 to 50 inches; light brownish gray (2.5Y 6/2) gravelly loamy coarse sand, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable; few very fine and fine roots; few very fine tubular pores; neutral (pH 6.6); clear smooth boundary.

C2-50 to 58 inches; light olive gray (5Y 6/2) loamy coarse sand, light olive gray (5Y 6/2) moist; massive; slightly hard, friable; few very fine and fine roots; few very fine tubular pores; neutral (pH 7.0); clear smooth boundary.

C3-58 to 64 inches; light yellowish brown (2.5Y 6/4) loamy coarse sand; massive; slightly hard, friable; few very fine roots; few very fine tubular pores; neutral (pH 6.9).

The solum is 30 to 35 inches thick. Granite or andesite is at a depth of 50 to 60 inches or more. Reaction is medium acid to neutral.

The A horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 or 5, dry, and 2 or 3, moist; and chroma of 1 or 2.

The C horizon has hue of 2.5Y or 5Y; value of 6 or 7, dry, and 4 through 6, moist; and chroma of 2 through 4. It is gravelly loamy coarse sand, loamy coarse sand, or loamy sand.

Elkcreek series

The Elkcreek series consists of moderately deep, well drained soils that formed in material that weathered from andesite, basalt, and rhyolite. Elkcreek soils are on up lands. The slopes are 0 to 60 percent. The average

annual precipitation is 14 inches, and the average annual temperature is 41 degrees F.

Elkcreek soils are similar to Simonton soils, and they are near Gaib, Polecreek, and Simonton soils. Unlike Elkcreek soils, Simonton soils are deeper than 40 inches to bedrock. Gaib and Polecreek soils are 10 to 20 inches deep to bedrock.

Typical profile (fig. 7) of Elkcreek loam, 0 to 30 percent slopes, 13 miles east and 10 miles south of Fairfield; 300 feet east and 2,200 feet south of the NW corner of sec. 34, T. 2 S., R. 16 E.

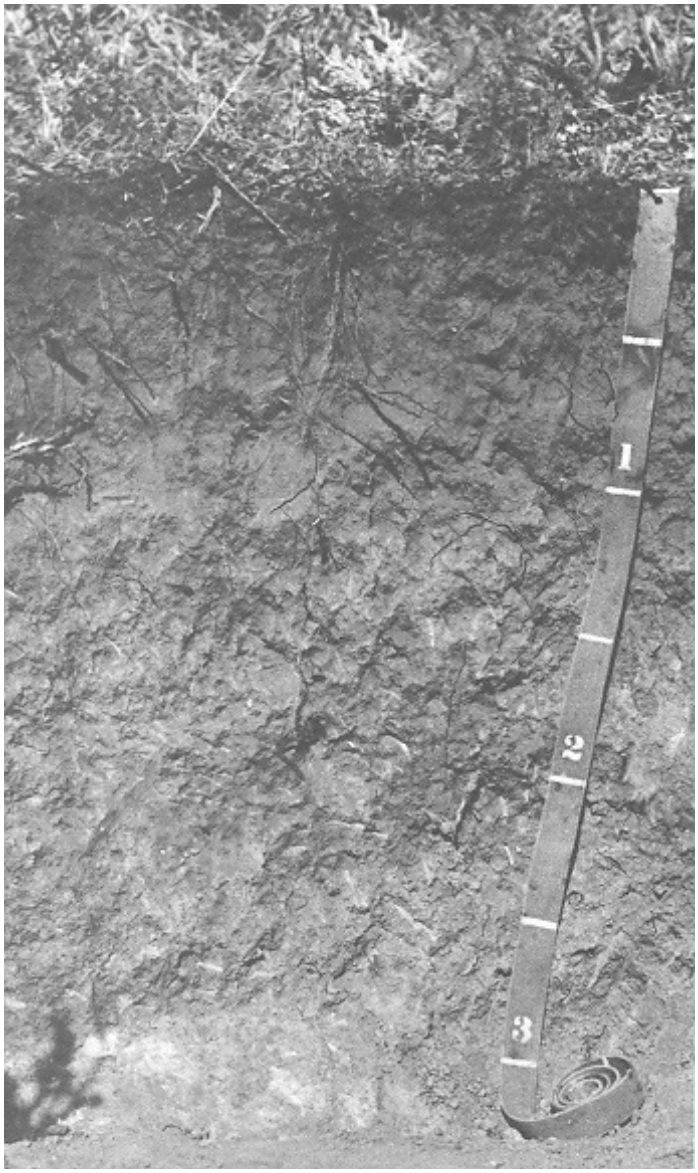

Figure 7.-Profile of Elkcreek loam, 0 to 30 percent slopes.

A11-0 to 3 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak thin platy structure that parts to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine interstitial pores; 10 percent fine gravel; slightly acid (pH 6.4); clear smooth boundary.

A12-3 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine, few medium and coarse roots; many fine tubular pores; neutral (pH 6.6); clear wavy boundary.

B1-8 to 12 inches; brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine tubular pores; neutral (pH 6.6); clear smooth boundary.

B21t-12 to 22 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3), dark brown (10YR 4/3) rubbed, moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few very fine, fine, and medium roots; many fine tubular pores; common thin clay films on faces of peds; neutral (pH 6.6); gradual smooth boundary.

B22t-22 to 31 inches; pale brown (10YR 6/3) clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few medium and coarse roots; many fine and medium pores; common nearly continuous clay films on faces of peds and lining pores; slightly acid (pH 6.4); clear smooth boundary.

R-31 inches; bedrock.

The solum is 26 to 36 inches thick. The mollic epipedon is 10 to 16 inches thick and includes parts of the argillic horizon. Bedrock is at a depth of 26 to 40 inches. The soil has a base saturation of 50 to 75 percent in some part above a depth of 75 centimeters. Reaction is slightly acid to neutral.

The A horizon has value of 4 or 5, dry, and 2 or 3, moist, and chroma of 1 through 3.

The B2t horizon has hue of 10YR or 7.5YR; value of 5 or 6, dry, and 3 through 5, moist; and chroma of 2 through 4. The brighter colors are in the lower part of the profile. This horizon is clay loam, sandy clay loam, or silty clay loam.

Gaib series

The Gaib series consists of shallow, well drained soils that formed in material that weathered from basalt, rhyolite, and andesite. Gaib soils are on uplands. The slopes are 0 to 60 percent. The average annual precipitation is 14 inches, and the average annual temperature is 40 degrees F.

Gaib soils are similar to Polecreek soils and they are near Elkcreek, Harahill, and Winu soils. Unlike Gaib soils, Polecreek soils are more than 35 percent clay in the argillic horizon. Elkcreek, Harahill, and Winu soils do not have bedrock within a depth of 20 inches.

Typical profile of Gaib very gravelly loam in an area of Gaib-Winu complex, 30 to 60 percent slopes, about 2 miles east and 7 miles south of Fairfield; 1,600 feet west and 1,800 feet south of the northeast corner of sec. 23, T. 2 S., R. 14 E.

A1-0 to 4 inches; grayish brown (10YR 5/2) very gravelly loam, very dark grayish brown (10YR 3.2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine interstitial pores; 40 percent gravel; medium acid (pH 6.0); clear smooth boundary.

B21t-4 to 9 inches; brown (10YR 5/3) very cobbly sandy clay loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine tubular pores; few thin clay films on faces of peds and lining pores; 35 percent gravel, 20 percent cobblestones and stones; slightly acid (pH 6.2); clear wavy boundary.

B22t-9 to 13 inches; brown (7.5YR 5/4) very stony clay loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; common fine roots; few fine tubular pores; few thin clay films on faces of peds and lining pores; 20 percent gravel, 50 percent cobblestones and stones; slightly acid (pH 6.5); clear wavy boundary.

R-13 inches; bedrock.

The solum is 10 to 20 inches thick. The mollic epipedon is 7 to 12 inches thick and includes the upper part of the argillic horizon. Bedrock is at a depth of 10 to 20 inches. The solum is 35 to 70 percent, by volume, coarse fragments. Reaction is medium acid to neutral. The base saturation is 50 to 75 percent in some part above a depth of 75 centimeters.

The A horizon has value of 4 or 5, dry, and 2 or 3, moist, and chroma of 2 or 3, moist and dry.

The B2t horizon has hue of 7.5YR or 10YR; value of 4 or 5, dry, and 3 or 4, moist; and chroma of 2 through 4, moist and dry. The brighter colors are in the lower part of the horizon. This horizon is very gravelly or very cobbly sandy clay loam, very stony clay loam, silty clay loam, or very gravelly loam and contains 24 to 35 percent clay.

Harahill series

The Harahill series consists of moderately deep, well drained soils that formed in material that weathered from basalt and rhyolite. Harahill soils are on lava plains and uplands. The slopes are 0 to 30 percent. The average annual precipitation is 14 inches, and the average annual temperature is 42 degrees F.

Harahill soils are similar to Bauscher, Brinegar, and Riceton soils and are near Laurentzen and Polecreek soils. Unlike Harahill soils, Bauscher, Brinegar, and Laurentzen soils are deeper than 40 inches to bedrock. Polecreek soils are 10 to 20 inches deep to bedrock. Riceton soils are coarse-loamy.

Typical profile of Harahill loam in an area of Harahill-Polecreek complex, 0 to 30 percent slopes, about 1 mile west and 2 miles north of Hill City; 250 feet west and 1,300 feet north of the SE corner of sec. 18, T. 1 S., R. 12 E.

A11-0 to 4 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate very thin platy structure that parts to moderate very fine granular; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine interstitial pores; 10 percent, by volume, gravel; medium acid (pH 6.0); clear smooth boundary.

A12-4 to 12 inches; brown (7.5YR 4/2) loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine and fine and few medium and coarse roots; many very fine and fine tubular pores; 5 percent, by volume, gravel; slightly acid (pH 6.2); clear wavy boundary.

B2t-12 to 20 inches; brown (7.5YR 4/2) loam, dark reddish brown (5YR 3/3) moist; moderate medium prismatic structure that parts to moderate fine and medium subangular blocky; hard, firm, sticky and plastic; common very fine and fine and few medium and coarse roots; many fine tubular pores; common moderately thick clay films on faces of peds and lining pores; 10 percent, by volume, gravel; slightly acid (pH 6.3); clear wavy boundary.

B3-20 to 26 inches; brown (7.5YR 4/2) very gravelly loam, dark reddish brown (5YR 3/3) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common fine tubular pores; few thin clay films on faces of peds and lining pores; 15 percent cobblestones and 45 percent gravel, by volume; slightly acid (pH 6.3); gradual irregular boundary.

Cr-26 to 29 inches; moderately decomposed basalt that can be cut with a knife; interior is dark gray (N 4/0), and very dark gray (N 3/0) moist; exterior coatings are brown (7.5YR 5/4) and reddish brown (5YR 4/4) moist.

R-29 inches; bedrock.

The solum is 20 to 28 inches thick. Bedrock is at a depth of 24 to 36 inches. Reaction is medium acid to slightly acid. The base saturation is 50 to 75 percent in some part above a depth of 75 centimeters.

The A1 horizon has hue of 10YR through 5YR; value of 4 or 5, dry, and 2 or 3, moist; and chroma of 2 or 3, moist or dry. It is loam, stony loam, or clay loam, and is 5 to 20 percent rock fragments. The B2t horizon has hue of 7.5YR or 5YR and value of 4 or 5, dry. It is silt loam, loam, or clay loam and is 5 to 20 percent rock fragments.

Houk series

The Houk series consists of very deep, somewhat poorly drained soils that formed in alluvium that weathered from andesite, granite, rhyolite, and basalt. Houk soils are on low terraces and bottom lands and have slopes of 0 to 2 percent. The average annual precipitation is 14 inches, and the average annual temperature is 41 degrees F.

Houk soils are near Brinegar, Marshdale, Strom, and Vodermaier soils. Unlike Houk soils, Brinegar soils are moderately well drained, and they do not have an A2 horizon or a clayey Bt horizon. Marshdale soils do not have a Bt horizon. Strom soils have a clay loam or loam subsoil. Vodermaier soils are well drained, they do not have a Bt horizon, and they are sandy.

Typical profile of Houk silty clay loam, 4 miles west and 3 miles south of Fairfield; 490 feet west and 50 feet north of the SE corner of sec. 26, T. 1 S., R. 13 E.

Ap-0 to 8 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium su-bangular blocky structure that parts to moderate fine and medium granular; slightly hard, friable, sticky and plastic; many fine roots; many very fine interstitial pores; slightly acid (pH 6.4); clear smooth boundary.

A2-8 to 13 inches; gray (10YR 6/1) silty clay loam, dark gray (10YR 4/1) moist; weak thick platy structure that parts to moderate medium and coarse subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common very fine vesicular and many very fine tubular pores; slightly acid (pH 6.4); abrupt smooth boundary.

B21t-13 to 25 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; weak medium prismatic structure that parts to medium angular blocky; hard, firm, very sticky and very plastic; many fine roots; many fine tubular pores; common thin gray (10YR 6/1) silt coatings on vertical faces of peds; common thin clay films on vertical faces of peds and lining pores; neutral (pH 6.6); abrupt smooth boundary.

B22t-25 to 31 inches; dark gray (10YR 4/1) clay, black (10YR 2/1) moist; moderate medium prismatic structure that parts to moderate medium angular blocky; very hard, very firm, very sticky and very plastic; many fine roots; many very fine and fine tubular pores; continuous thin clay films on faces of peds and lining pores; moderately alkaline (pH 8.2); gradual wavy boundary.

B23tca-31 to 38 inches; gray (10YR 5/1) clay loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure that parts to moderate medium angular blocky; very hard, very firm, very sticky and very plastic; many fine roots; few fine tubular pores; many thin clay films on faces of peds and lining pores; common medium rounded soft lime masses; moderately alkaline (pH 8.3); clear wavy boundary.

B3tca-38 to 46 inches; gray (10YR 5/1) clay loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure that parts to moderate medium angular blocky; very hard, firm, sticky and plastic; many very fine roots on vertical faces of peds; few very fine tubular pores; few thin clay films on faces of peds and lining pores; few fine manganese concretions; moderately calcareous; moderately alkaline (pH 8.4); clear smooth boundary.

C1gca-46 to 57 inches; light gray (5Y 7/2) sandy clay loam, gley colors are dark greenish gray (5G 4/1) and dark bluish gray (5B 4/1) moist; common medium prominent mottles, strong brown (7.5YR 5/6) and brown (7.5YR 4/4) moist; massive; hard, firm, slightly sticky and slightly plastic; many fine roots; moderately calcareous; lime segregated in common fine rounded soft masses; moderately alkaline (pH 8.4); abrupt wavy boundary.

C2g-57 to 61 inches; gray (5Y 6/1) sandy loam, dark greenish gray (5G 4/1) moist; common prominent mottles that are yellowish brown (10YR 5/6), dark yellowish brown (10YR 4/4), and greenish gray (5YR 6/1) moist; massive; very weakly cemented; hard, firm; moderately alkaline (pH 8.0).

The solum is 39 to 50 inches thick. Reaction ranges from slightly acid in the surface layer to moderately alkaline in the substratum. The water table is at a depth of 30 inches in spring and at a depth of about 60 inches in fall.

The A1 or Ap horizon has value of 4 or 5, dry, and 2 or 3, moist, and chroma of less than 2, dry and moist. The A2 horizon has hue of 10YR or 2.5Y; value of 5 through 7, dry, and 3 or 4, moist; and chroma of 1 or 2. The texture ranges from sandy loam to silty clay loam.

The B2t horizon has hue of 10YR or 2.5Y, or it is neutral. It has value of 4 through 6, dry, and 2 through 4, moist, and chroma of 0 through 2. It is heavy clay loam or clay.

A weak ca horizon is present in some pedons between depths of 30 and 54 inches. The C horizon is characterized by wetness, manganese concretions, and mottling at a depth of 30 to 46 inches. It is sandy clay loam and sandy loam.

Kevanton series

The Kevanton series consists of deep and very deep, well drained soils that formed in eolian material over basalt. Kevanton soils are on lava plains and have slopes of 0 to 25 percent. The average annual precipita-

tion is 13 inches, and the average annual temperature is 43 degrees F.

Kevanton soils are near Gaib, Manard, and Magic soils. Gaib soils are less than 20 inches deep to bedrock. Manard soils are 20 to 40 inches deep to bedrock. Magic soils are 20 to 40 inches deep to bedrock, and they are silty clay in the surface layer.

Typical profile of Kevanton sandy loam in an area of Kevanton-Rock outcrop complex, 0 to 25 percent slopes, about 4 miles south and 15 miles east of Fairfield; 400 feet east and 150 feet north of the SW corner of sec. 30, T. 1 S., R. 17 E.

A1-0 to 11 inches; brown (10YR 5/3) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; many very fine and fine roots; many fine vesicular pores; medium acid (pH 6.0); clear smooth boundary.

B1t-11 to 25 inches; pale brown (10YR 6/3) sandy loam, dark brown (7.5YR 4/4) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and slightly plastic; common very fine and fine and few coarse roots; many fine and medium tubular pores; few thin clay films on faces of peds and lining pores; slightly acid (pH 6.1); clear wavy boundary.

B21t-25 to 34 inches; pale brown (10YR 6/3) sandy clay loam, dark brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to moderate fine and medium angular blocky; hard, firm, sticky and plastic; few fine roots; many fine tubular pores; few thin clay films on faces of peds and lining pores; common bleached sand and silt grains on vertical faces of peds; slightly acid (pH 6.2); abrupt wavy boundary.

IIB22bt-34 to 44 inches; brown (7.5YR 5/4) clay, brown (7.5YR 5/4) moist; strong medium and coarse prismatic structure parting to strong medium angular blocky; very hard, very firm, very sticky and very plastic; few very fine, fine, and medium roots; few fine tubular pores; common moderately thick clay films on faces of peds; mildly alkaline (pH 7.4); abrupt wavy boundary.

IIC1-44 to 53 inches; reddish yellow (7.5YR 6/6) loam, yellowish red (5YR 4/6) moist; moderate thin platy structure; very hard, very firm, slightly sticky and slightly plastic; common very fine and few medium roots concentrated along horizontal faces of peds; mildly alkaline (pH 7.6); clear wavy boundary.

IIC2-53 to 60 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; moderate medium and fine subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few fine roots; many fine tubular pores; mildly alkaline (pH 7.7); clear wavy boundary.

IIC3-60 to 66 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; moderate fine angular blocky structure; hard, firm, slightly sticky and slightly plastic; few fine roots; few fine tubular pores; mildly alkaline (pH 7.7).

The solum is 40 to 48 inches thick. The mollic epipedon is 10 to 12 inches thick. Reaction is medium to slightly acid in the surface layer and ranges to mildly alkaline in the substratum. The base saturation is 50 to 75 percent in some part above a depth of 75 centimeters. Bedrock is at a depth of 44 to 60 or more inches.

The A horizon has value of 4 or 5, dry, and 2 or 3, moist, and chroma of 2 or 3.

The B2t horizon has hue of 7.5YR or 10YR; value of 5 or 6, dry, and 3 through 5, moist; and chroma of 3 or 4. It is sandy loam or sandy clay loam in the upper part and clay in the lower part.

The C horizon has value of 6 or 7, dry, and 4 or 5, moist, and chroma of 4 through 6.

Laurentzen series

The Laurentzen series consists of very deep, well drained soils that formed in alluvium and residuum that derived from basalt. Laurentzen soils are on alluvial fans and lava plains and have slopes of 0 to 12 percent. The average annual precipitation is 14 inches, and the average annual temperature is 40 degrees F.

Laurentzen soils are similar to the Bauscher, Harahill, and Brinegar soils. Unlike Laurentzen soils, these soils have a control section that is more than 15 percent material coarser than fine sand. Laurentzen soils are near Gaib, Harahill, Manard, Magic, and Polecreek soils. Gaib and Polecreek soils have bedrock within a depth of 20 inches. Harahill, Manard, and Magic soils are 20 to 40 inches deep to bedrock.

Typical profile of Laurentzen loam, 0 to 12 percent slopes, about 2.5 miles north and 2 miles west of Hill City; 1,400 feet east and 2,300 feet south of the NW corner of sec. 18, T. 1 S., R. 12 E.

A11-0 to 7 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) moist; weak medium platy structure that parts to weak fine granular; soft, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine interstitial pores; slightly acid (pH 6.4); clear smooth boundary.

A12-7 to 14 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure that parts to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common fine and medium tubular pores; neutral (pH 6.6); clear wavy boundary.

B1t-14 to 23 inches; brown (7.5YR 5/2) light clay loam, dark brown (7.5YR 3/2) moist; weak medium and coarse prismatic structure that parts to moderate medium and coarse subangular blocky; slightly hard, firm, sticky and plastic; many very fine and fine

roots; many fine and medium tubular pores; thin nearly continuous clay films on faces of peds; neutral (pH 6.6); clear wavy boundary.

B21t-23 to 30 inches; brown (7.5YR 5/2) clay loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure that parts to moderate medium subangular blocky; hard, firm, sticky and plastic; many very fine and fine roots; many fine and medium tubular pores; thin continuous clay films on faces of peds; many krotovina, 1 to 2 centimeters; neutral (pH 6.6); clear irregular boundary.

B22t-30 to 42 inches; brown (7.5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine and fine roots; many fine and medium tubular pores; thin continuous clay films on faces of peds; neutral (pH 6.6); clear wavy boundary.

B3t-42 to 60 inches; brown (7.5YR 5/4) cobbly clay loam, dark reddish brown (5YR 3/4) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, sticky and plastic; few fine roots; many fine and medium pores; thin patchy clay films on horizontal and vertical faces of peds; 15 percent basalt cobblestones and 20 percent gravel; neutral (pH 6.8).

The solum is 28 to more than 60 inches thick. The mollic epipedon is 20 to 35 inches thick and may include a part of the argillic horizon. Reaction ranges from slightly acid to neutral. The base saturation is 50 to 75 percent in some part above a depth of 75 centimeters.

The A1 horizon has hue of 10YR or 7.5YR and value of 4 or 5, dry, and 2 or 3, moist. It is loam or silt loam.

The B2t horizon has hue of 7.5YR or 5YR; value of 4 or 5, dry, and 3 or 4, moist; and chroma of 2 through 4. It is heavy loam, silty clay loam, or clay loam.

Little Wood series

The Little Wood series consists of very deep, well drained soils that formed in mixed alluvium. Little Wood soils are on alluvial fans and terraces and have slopes of 0 to 4 percent. The average annual precipitation is 14 inches, and the average annual temperature is 43 degrees F.

The Little Wood soils are near Rands, Simonton, and Vodermaier soils. Unlike Little Wood soils, Rands and Simonton soils are less than 15 percent coarse fragments in the A horizon and the B2t horizon. Rands soils are more than 35 percent clay in the B2t horizon. Vodermaier soils are less than 18 percent clay in the control section, and they do not have a B2t horizon.

Typical profile (fig. 8) of Little Wood very gravelly loam, 0 to 4 percent slopes, about 3 miles east and 3 miles north of Fairfield; 150 feet west and 450 feet north of the SE corner of sec. 25, T. 1 N., R. 14 E.

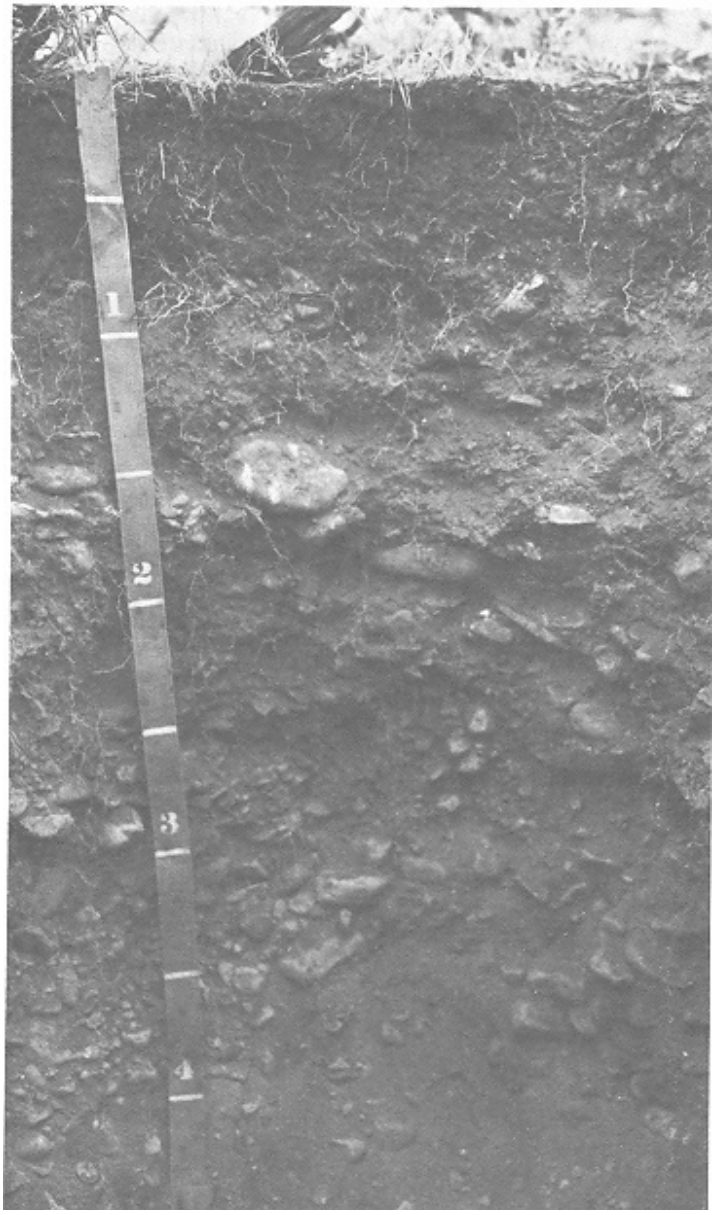

Figure 8.-Profile of Little Wood very gravelly loam, 0 to 4 percent slopes.

Ap-0 to 8 inches; grayish brown (10YR 5/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many fine interstitial pores; slightly acid (pH 6.4); clear smooth boundary.

A12-8 to 14 inches; grayish brown (10YR 5/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky

structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many fine tubular pores; slightly acid (pH 6.4); clear wavy boundary.

B1t-14 to 19 inches; brown (10YR 5/3) very gravelly sandy clay loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common fine and medium roots; many fine tubular pores; few thin clay films on vertical faces of peds and lining pores; slightly acid (pH 6.4); clear wavy boundary.

B2t-19 to 30 inches; pale brown (10YR 6/3) very gravelly sandy clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable; sticky and plastic; common fine and medium roots; many fine tubular pores; few moderately thick clay films on vertical faces of peds and lining pores; neutral (pH 6.6); clear wavy boundary.

C1-30 to 46 inches; pale brown (10YR 6/3) very gravelly loamy coarse sand, brown (10YR 4/3) moist; massive; soft, very friable; many fine and medium roots; many fine tubular pores; neutral (pH 7.0); gradual wavy boundary.

C2-46 to 60 inches; very gravelly coarse sand, single grained; loose; few fine roots; neutral (pH 7.0).

The solum is 21 to 34 inches thick. The mollic epipedon is 11 to 19 inches thick. Reaction is medium acid to neutral. The base saturation is 50 to 75 percent in some part above a depth of 75 centimeters.

The A horizon is very gravelly loam or gravelly loam. It has value of 4 or 5, dry, and 2 or 3, moist, and chroma of 1 or 2.

The B2t horizon has hue of 10YR or 7.5YR; value of 4 through 6, dry, and 3 or 4, moist; and chroma of 2 or 3. It is very gravelly loam, very gravelly sandy clay loam, or very gravelly clay loam; and it is 35 to 55 percent, by volume, gravel and 5 percent cobblestones.

The C horizon is 50 to 80 percent, by volume, gravel and 0 to 10 percent cobblestones.

Lockman series

The Lockman series consists of deep, well drained soils that formed in residuum of andesite, granite, and other igneous rocks. Lockman soils are on mountains and hills and have slopes of 30 to 60 percent. The average annual precipitation is 20 inches, and the average annual temperature is 38 degrees F.

Lockman soils are similar to Earcree soils and are near Elkcreek, Gaib, and Roanhide soils. Unlike Lockman soils, Earcree soils have a mollic epipedon that is thicker than 15 inches. Elkcreek and Roanhide soils are 20 to 40 inches deep to bedrock. Gaib soils are 10 to 20 inches deep to bedrock.

Typical profile of Lockman stony sandy loam, 30 to 60 percent slopes, about 5 miles west and 6 miles north of Corral; 1,100 feet east and 1,900 feet south of the NW corner of sec. 16, T. 1 N., R. 12 E.

O1-2 inches to 1 inch; undecomposed leaves, needles, twigs, and cones.

O2-1 inch to 0; partially decomposed needles, leaves, and twigs.

A1-0 to 13 inches; dark grayish brown (10YR 4/2) stony sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure that parts to weak fine granular; soft, very friable; many very fine, fine, medium, and coarse roots; many very fine and fine interstitial pores; about 30 to 40 percent rounded (5 to 10 centimeters) krotovinas that are brown (10YR 5/3), dry, and very dark grayish brown (10YR 3/2), moist; slightly acid (pH 6.3); clear smooth boundary.

B2-13 to 19 inches; very pale brown (10YR 7/3) sandy loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many very fine and fine and few medium and coarse roots; many fine tubular pores; 5 percent, by volume, gravel; about 30 percent rounded (5 to 10 centimeters) krotovinas that are light grayish brown (10YR 6/2), dry, and grayish brown (10YR 5/2), moist; medium acid (pH 6.0); gradual smooth boundary.

C1-19 to 29 inches; pale olive (5Y 6/3) sandy loam, olive (5Y 5/3) moist; massive; slightly hard, friable; common very fine and fine and few medium and coarse roots; many very fine and fine tubular pores; slightly acid (pH 6.5); abrupt smooth boundary.

C2-29 to 39 inches; light yellowish brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable; few very fine and fine roots; many fine and medium tubular pores; medium acid (pH 6.0); gradual wavy boundary.

C3-39 to 48 inches; light yellowish brown (10YR 6/4) cobbly sandy loam, yellowish brown (10YR 5/4) moist; massive; soft, friable; few very fine and fine roots; common very fine interstitial pores; 25 percent gravel, and 15 percent cobblestones by volume; medium acid (pH 6.0).

R-48 inches; hard andesite bedrock.

The solum is 16 to 24 inches thick. The mollic epipedon is 10 to 15 inches thick. Bedrock is at a depth of 40 to 60 inches.

The A horizon has a value of 3 through 5, dry, and 2 or 3, moist, and chroma of 1 or 2, moist or dry.

The B horizon has value of 6 or 7, dry, and 4 or 5, moist, and chroma of 2 through 4, moist and dry. It is sandy loam or gravelly sandy loam.

The C horizon has hue of 10YR through 5Y; value of 6 through 8, dry, and 4 through 6, moist; and chroma of 3 through 6, moist and dry. It is sandy loam, gravelly sandy loam, or cobbly sandy loam.

Magic series

The Magic series consists of moderately deep, well drained soils that formed in residuum of basalt. Magic soils are on lava plains and have slopes of 0 to 8 percent. The average annual precipitation is 14 inches, and the average annual temperature is 41 degrees F.

Magic soils are similar to Yutrue soils. They are near Gaib, Harahill, Kevanton, Laurentzen, Manard, and Polecreek soils. Unlike Magic soils, Yutrue soils are warmer than 47 degrees F. Gaib and Polecreek soils are 10 to 20 inches deep to bedrock. Harahill soils are less than 35 percent clay. Kevanton and Laurentzen soils are more than 40 inches deep to bedrock. Manard soils have a silt loam surface layer and a clay argillic horizon.

Typical profile (fig. 9) of Magic very stony silty clay, 0 to 8 percent slopes, about 9 miles east and 5 miles south of Fairfield; 1,650 feet west and 250 feet south of the NE corner of sec. 7, T. 2 S., R. 16 E.

A1-0 to 3 inches; brown (10YR 5/3) very stony silty clay, dark brown (10YR 4/3) moist; strong very fine granular structure; soft, very friable, sticky and plastic; few fine and medium roots; many very fine interstitial pores; neutral (pH 7.2); clear smooth boundary.

B21-3 to 6 inches; brown (7.5YR 5/2) silty clay, dark brown (7.5YR 4/2) moist; moderate thick platy structure that parts to moderate fine and medium angular blocky; very hard, very firm, very sticky and very plastic; few very fine and fine roots; few fine tubular pores; mildly alkaline (pH 7.8); clear wavy boundary.

B22-6 to 16 inches; brown (7.5YR 5/2) silty clay, dark brown (7.5YR 4/2) moist; weak very coarse prismatic structure that parts to moderate fine and medium angular blocky; very hard, very firm, very sticky and very plastic; few very fine and fine roots; few fine tubular pores; prisms tilted to 60 degree angle from vertical; mildly alkaline (pH 7.8); clear wavy boundary.

B31-16 to 26 inches; pinkish gray (7.5YR 6/2) silty clay, brown (7.5YR 4/2) moist; weak very coarse prismatic structure that parts to moderate fine and medium angular blocky; very hard, very firm, very sticky and very plastic; few very fine, fine, medium, and coarse roots; few fine tubular pores; moderately alkaline (pH 8.0); clear wavy boundary.

B32ca-26 to 33 inches; pinkish gray (7.5YR 6/2) silty clay, brown (7.5YR 4/2) moist; moderate fine and medium angular blocky structure; hard, firm, sticky and plastic; few very fine and fine roots; few fine tubular pores; slightly calcareous veins and matrix; moderately alkaline (pH 8.2); clear wavy boundary.

B33ca-33 to 35 inches; pinkish gray (7.5YR 6/2) silty clay loam, brown (7.5YR 4/2) moist; strong fine and medium angular blocky structure; hard, firm, sticky

Figure 9.-Profile of Magic silty clay in an area of Magic very stony silty clay, 0 to 8 percent slopes.

and plastic; few very fine roots; moderately calcareous veins and coatings on faces of peds; moderately alkaline (pH 8.2); abrupt wavy boundary.

R-35 inches; bedrock.

The profile is 5 to 15 percent gravel, cobblestones, and stones. The depth to basalt and the thickness of the solum are 25 to 40 inches. Reaction is neutral to moderately alkaline.

The A horizon has hue of 7.5YR or 10YR; value of 5 or 6, dry; and chroma of 2 or 3, moist and dry.

The B horizon has value of 5 or 6, dry, and chroma of 2 or 3, moist and dry. It is clay, silty clay, and silty clay loam.

Manard series

The Manard series consists of moderately deep, well drained soils that formed in material that weathered from basalt and rhyolite. Manard soils are on lava plains and uplands and have slopes of 0 to 30 percent. The average annual precipitation is 14 inches, and the average annual air temperature is 41 degrees F.

Manard soils are similar to Bostrum soils and are near Gaib, Harahill, Kevanton, Laurentzen, Magic, and Polecreek soils. Unlike Manard soils, Bostrum soils have an abrupt change in texture and a mean annual soil temperature that is above 47 degrees F. Gaib and Polecreek soils are 10 to 20 inches deep to bedrock. Harahill soils have a fine-loamy control section. Kevanton and Laurentzen soils are more than 40 inches deep to bedrock. Magic soils are clayey throughout.

Typical pedon of Manard very stony silt loam in an area of Manard-Rock outcrop complex, 0 to 8 percent slopes, about 8 miles east and 4.75 miles south of Fairfield; 1,300 feet west and 2,000 feet north of the southeast corner of sec. 2, T. 2 S., R. 15 E.

A11-0 to 3 inches; grayish brown (10YR 5/2) very stony silt loam, very dark grayish brown (10YR 3/2) moist; moderate thin and very thin platy structure that parts to moderate very fine granular; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine interstitial pores; cobblestones cover 5 percent of the surface, and stones cover 1 percent; slightly acid (pH 6.3); clear smooth boundary.

A12-3 to 9 inches; grayish brown (10YR 5/2) very stony silty clay loam, dark brown (10YR 3/3) moist; moderate medium angular blocky structure that parts to strong fine granular; hard, friable, slightly sticky and slightly plastic; common very fine and fine and few medium roots; many fine tubular pores; 5 percent cobblestones and 1 percent stones imbedded from the surface; slightly acid (pH 6.3); clear wavy boundary.

B21t-9 to 18 inches; pale brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) moist; weak medium prismatic structure that parts to moderate very fine and fine angular blocky; very hard, firm, sticky and plastic; common very fine and fine and few medium roots; common fine tubular pores; many moderately thick clay films on faces of peds; common bleached sand and silt grains on the vertical faces of peds; 5 percent cobblestones and 1 percent stones; slightly acid (pH 6.4); abrupt wavy boundary.

B22t-18 to 26 inches; light yellowish brown (10YR 6/4) silty clay, dark brown (10YR 4/3) moist; strong medium prismatic structure that parts to strong medium angular blocky; very hard, very firm, very sticky and very plastic; common very fine roots; common fine tubular pores; continuous moderately thick clay films on faces of peds; 5 percent angular cobblestones and 7 percent stones; mildly alkaline (pH 7.6); abrupt wavy boundary.

Ccasim-26 to 28 inches; white (10YR 8/1) silica-cemented hardpan; strong thin platy; very hard, very firm; moderately calcareous; mildly alkaline (pH 7.6); abrupt wavy boundary.

R-28 inches; basalt.

The solum is 19 to 34 inches thick. The mollic epipedon is 7 to 10 inches thick. The surface cover is 1 to 5 percent stones and 5 percent cobblestones. Reaction ranges from slightly acid to mildly alkaline. Bedrock is at a depth of 21 to 38 inches.

The A1 horizon has hue of 10YR or 7.5YR; value of 4 or 5, dry, and 2 or 3, moist; and chroma of 2 or 3, moist or dry.

The B2t horizon has hue of 10YR through 5YR; value of 5 or 6, dry, and 3 or 4, moist; and chroma of 3 or 4, moist or dry. It is silty clay loam, silty clay, or clay and ranges from 35 to 50 percent in content of clay.

The C horizon is a silica-cemented pan that contains small fragments of decomposing bedrock. It ranges from slightly to moderately calcareous above the bedrock.

Marshdale series

The Marshdale series consists of very deep, poorly drained soils that formed in mixed alluvium that derived from granite, andesite, rhyolite, and basalt. Marshdale soils are on bottom lands. Slopes are 0 to 4 percent. The average annual precipitation is 13 inches, and the average annual temperature is 45 degrees F.

Marshdale soils are near Houk and Strom soils. Unlike Marshdale soils, Houk and Strom soils are somewhat poorly drained.

Typical pedon of Marshdale loam, 0 to 4 percent slopes, about 2 miles west and 1.5 miles south of Fairfield; near the southwest corner of the SE1/4NW1/4 sec. 20, T. 1 S., R. 14 E.

Ap-0 to 7 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate fine and very fine granular structure; slightly hard, friable, slightly sticky

and slightly plastic; many fine roots; many interstitial pores; neutral (pH 6.6); clear wavy boundary.

A12-7 to 20 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to moderate fine granular; hard, friable, slightly sticky and slightly plastic; common fine roots, except few fine roots below a depth of 14 inches; common very fine and few fine tubular pores; neutral (pH 7.0); gradual smooth boundary.

A13g-20 to 33 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; few fine distinct light yellowish brown (10YR 6/4) mottles, dark yellowish brown (10YR 4/4) moist; weak medium angular blocky structure; hard, firm, sticky and plastic; few fine roots; common very fine tubular pores; mildly alkaline (pH 7.8); clear smooth boundary.

IIC1g-33 to 47 inches; light gray (10YR 6/1) clay loam, very dark gray (10YR 3/1) moist; few fine distinct light yellowish brown (10YR 6/4) mottles, dark yellowish brown (10YR 4/4) moist; weak medium angular blocky structure; hard, friable, slightly sticky and slightly plastic; few roots; common very fine and few fine tubular pores; moderately alkaline (pH 8.0); clear smooth boundary.

IIIC2-47 to 60 inches; light gray (10YR 6/1) loamy coarse sand, dark grayish brown (2.5Y 4/2) moist; few mottles; single grained; loose; few roots; water table at a depth of 57 inches; moderately alkaline (pH 8.0); abrupt smooth boundary.

IVC3-60 to 65 inches; reddish yellow (7.5YR 6/6) coarse sand, brown (7.5YR 4/4) moist; single grained; loose; mildly alkaline (pH 7.6).

The soils are slightly acid to moderately alkaline. The water table fluctuates between depths of 12 and 60 inches. Mottles are common above a depth of 30 inches, and they are distinct or prominent.

The A horizon has hue of 10YR or 2.5Y; value of 3 or 4, dry, and 2 or 3, moist; and chroma of 1 or 2, moist and dry.

The IIC horizon has hue of 10YR or 2.5Y; value of 5 or 6, dry, and 3 or 4, moist; and chroma of 1 or 2, moist and dry.

Polecreek series

The Polecreek series consists of shallow, well drained soils that formed in material that weathered from rhyolite or basalt. Polecreek soils are on uplands and lava plains and have slopes of 0 to 60 percent. The average annual precipitation is 14 inches, and the average annual temperature is 40 degrees F.

Polecreek soils are similar to Gaib and Manard soils and are near Elkcreek, Harahill, Laurentzen, and Winu soils. Unlike Polecreek soils, Gaib soils are less than 35 percent clay in the argillic horizon. Elkcreek, Harahill, and Manard soils are 20 to 40 inches deep to bedrock. Laurentzen soils are more than 40 inches deep to bed rock, and they have a thick mollic epipedon and a fine-silty control section. Winu soils have a thick mollic epipedon, a fine-loamy control section, and a cryic temperature regime.

Typical profile of Polecreek very gravelly loam in an area of Polecreek-Manard complex, 0 to 30 percent slopes, about 2 miles east and 7 miles south of Fairfield; 2,280 feet west and 1,860 feet south of the NE corner of sec. 23, T. 2 S., R. 14 E.

A11-0 to 4 inches; brown (10YR 5/3) very gravelly loam, dark brown (10YR 3/3) moist; weak thin platy structure that parts to moderate very fine and fine granular; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; many fine interstitial pores; slightly acid (pH 6.2); clear smooth boundary.

A12-4 to 9 inches; brown (10YR 5/3) very cobbly loam, dark brown (7.5YR 3/2) moist; moderate fine and medium subangular blocky structure that parts to moderate fine granular; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; 25 percent cobblestones and 10 percent gravel; slightly acid (pH 6.2); clear smooth boundary.

B2t-9 to 18 inches; light brown (7.5YR 6/4) very cobbly clay, dark reddish brown (5YR 3/4) broken and brown (7.5YR 4/4) rubbed moist; moderate medium and coarse prismatic structure that parts to moderate fine and medium subangular blocky; very hard, very firm, very sticky and very plastic; common very fine and fine roots on faces of peds; many very fine and fine tubular pores; continuous moderately thick clay films on faces of peds and lining pores; 40 percent cobblestones and 15 percent gravel; slightly acid (pH 6.4); abrupt broken boundary.

Cr-18 to 20 inches; slightly decomposed bedrock; exterior is brown (7.5YR 5/4), dry, and dark brown (7.5YR 3/4), moist; interior is dark gray (N 4/0), dry, and very dark gray (N 3/0), moist; few moderately thick silica coatings in cracks in bedrock.

R-20 inches; unweathered basalt.

The solum is 10 to 18 inches thick. It is 35 to 75 percent coarse fragments. Reaction ranges from slightly acid to neutral. The base saturation is 50 to 75 percent in some part above a depth of 75 centimeters. Bedrock is at a depth of 10 to 20 inches.

The A horizon has hue of 7.5YR or 10YR; value of 4 or 5, dry, and 2 or 3, moist; and chroma of 2 or 3, moist or dry.

The B2t horizon has hue of 5YR or 7.5YR; value of 5 or 6, dry, and 3 or 4, moist; and chroma of 3 or 4, moist or dry. It is commonly very cobbly clay but ranges to very cobbly clay loam or very cobbly silty clay loam, and it averages more than 35 percent in content of clay.

Rands series

The Rands series consists of very deep, well drained soils that formed in mixed alluvium that derived from acid and basic igneous rocks. Rands soils are on alluvial fans and terraces and have slopes of 0 to 25 percent. The average annual precipitation is 13 inches, and the average annual temperature is about 41 degrees F.

The Rands soils are similar to Bostrum soils. They are near the Brinegar, Simonton, and Vodermaier soils. Unlike Rands soils, the Bostrum soils do not have a mollic epipedon. Brinegar soils have a mollic epipedon that is more than 20 inches thick and a clay loam argillic horizon, and they are moderately well drained. Simonton soils have a fine-loamy control section, and they are noncalcareous. Vodermaier soils have a sandy control section.

Typical profile of Rands loam, 0 to 4 percent slopes, about 7 miles east of Fairfield; 925 feet east and 435 feet north of the southwest corner of sec. 11, T. 1 S., R. 15 E.

Ap-0 to 9 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure that parts to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine interstitial pores; slightly acid (pH 6.4); clear smooth boundary.

A12-9 to 17 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; many very fine and fine and common medium roots; many very fine and fine tubular pores; slightly acid (pH 6.2); abrupt wavy boundary.

B21t-17 to 20 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate fine angular blocky structure; very hard, firm, very sticky and very plastic; many very fine and fine and few medium roots; common very fine tubular pores; many moderately thick clay films on faces of peds and lining pores; common pinkish gray (7.5YR 7/2) silt coatings on vertical and horizontal faces of peds; slightly acid (pH 6.2); abrupt wavy boundary.

B22t-20 to 28 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate fine prismatic structure that parts to moderate fine angular blocky; very hard, very firm, very sticky and very plastic; many very fine and few medium roots on faces of peds; common very fine tubular pores; continuous moderately thick clay films on faces of peds and lining pores; neutral (pH 6.6); clear smooth boundary.

B23t-28 to 33 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate fine prismatic structure that parts to moderate very fine angular blocky; very hard, firm, sticky and plastic; common very fine roots; many very fine tubular pores; many moderately thick clay films on faces of peds and lining pores; mildly alkaline (pH 7.8); abrupt wavy boundary.

B3tca-33 to 41 inches; reddish yellow (7.5YR 6/6) fine gravelly clay loam, strong brown (7.5YR 5/6) moist; moderate medium prismatic structure that parts to moderate very fine and angular blocky; hard, firm, sticky and plastic; common very fine roots; many very fine tubular pores; many moderately thick clay films on faces of peds and lining pores; noncalcareous matrix, violently effervescent, lime segregated in common medium seams on vertical faces of peds; moderately alkaline (pH 8.0); abrupt wavy boundary.

C1-41 to 46 inches; pink (7.5YR 7/4) gravelly loamy sand, brown (7.5YR 4/4) moist; massive; slightly hard, very friable; few very fine roots; mildly alkaline (pH 7.8); gradual wavy boundary.

C2-46 to 60 inches; very pale brown (10YR 7/3) gravelly loamy coarse sand, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; few very fine roots; moderately alkaline (pH 8.0).

The solum is 30 to 50 inches thick. The mollic epipedon is 10 to 19 inches thick. Generally, the soil is slightly to moderately calcareous in the B3 or the C horizon, but in some pedons it is noncalcareous throughout.

The A horizon has chroma of 2 or 3.

The B2t horizon has hue of 10YR or 7.5YR; value of 5 or 6, dry; and chroma of 3 or 4. It is clay or clay loam.

The C horizon is gravelly loamy coarse sand through loam.

Riceton series

The Riceton series consists of very deep, well drained soils that formed mainly in alluvium that derived from acid igneous rocks. Riceton soils are on alluvial fans and terraces and have slopes of 0 to 12 percent. The average annual precipitation is 14 inches, and the average annual temperature is 41 degrees F.

Riceton soils are similar to Harahill and Roanhide soils. They are near Brinegar, Simonton, and Vodermaier soils. Unlike Riceton soils, Harahill soils are fine-loamy. Roanhide soils have a thinner mollic epipedon. Brinegar soils are moderately well drained, and they have a clay loam argillic horizon. Simonton soils do not have a pachic epipedon, and they have a fine-loamy argillic horizon. Vodermaier soils are sandy.

Typical profile of Riceton coarse sandy loam, 0 to 4 percent slopes, about 4.5 miles west and 1 mile south of Corral; 100 feet west and 500 feet south of the north quarter corner of sec. 21, T. 1 S., R. 12 E.

Ap-0 to 10 inches; grayish brown (10YR 5/2) coarse sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard,

very friable; many fine roots; many fine interstitial pores; medium acid (pH 5.8); clear wavy boundary.

A12-10 to 21 inches; grayish brown (10YR 5/2) coarse sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable; many fine roots; many fine tubular pores; medium acid (pH 5.8); clear wavy boundary.

B1-21 to 28 inches; brown (10YR 5/3) fine gravelly coarse sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable; many fine roots, many fine tubular pores; slightly acid (pH 6.4); clear wavy boundary.

B2-28 to 46 inches; pale brown (10YR 6/3) gravelly coarse sandy loam, brown (10YR 4/3) moist; weak medium and coarse subangular blocky structure; slightly hard, friable; common fine and few medium roots; many fine and medium tubular pores; neutral (pH 6.8); gradual wavy boundary.

C1-46 to 54 inches; pale brown (10YR 6/3) gravelly coarse sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable; few fine roots; many fine and medium tubular pores; neutral (pH 7.2); gradual *wavy* boundary.

C2-54 to 70 inches; light colored sand and gravel, mostly granitic alluvium.

The solum is 34 to 48 inches thick. The mollic epipedon is 22 to 30 inches thick. Coarse fragments make up 10 to 30 percent of the solum. Reaction ranges from medium acid to neutral. The base saturation is less than 75 percent in some part of the profile above a depth of 75 centimeters.

The A horizon has value of 4 or 5, dry, and 2 or 3, moist, and chroma of 1 or 2.

The B horizon has value of 5 or 6, dry, and 3 or 4, moist, and chroma of 2 or 3. It is coarse sandy loam or fine gravelly coarse sandy loam.

Roanhide series

The Roanhide series consists of moderately deep, well drained soils that formed in residuum of granite. Roanhide soils are on hills and mountains and have slopes of 4 to 60 percent. The average annual precipitation is 14 inches, and the average annual temperature is 40 degrees F.

Roanhide soils are similar to Harahill and Riceton soils and are near Bauscher, Earcree, and Lockman soils. Unlike Roanhide soils, Harahill soils are fine-loamy and have a pachic mollic epipedon. Bauscher, Earcree, and Lockman soils are deeper than 40 inches to bedrock. Riceton soils are deeper than 40 inches and have a pachic mollic epipedon.

Typical profile of Roanhide coarse sandy loam, 25 to 60 percent slopes, about 7 miles north and 1.25 miles east of Hill City; 2,000 feet east and 1,200 feet south of the NW corner of sec. 27, T. 1 N., R. 12 E.

A11-0 to 4 inches; grayish brown (10YR 5/2) coarse sandy loam, very dark grayish brown (10YR 3/2) moist; moderate very fine and fine granular structure; soft, very friable; many very fine and few medium roots; many very fine interstitial pores; neutral (pH 6.8); clear smooth boundary.

A12-4 to 9 inches; grayish brown (10YR 5/2) coarse sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable; many very fine and fine roots; many fine tubular pores; neutral (pH 7.2); clear smooth boundary.

B2-9 to 15 inches; brown (10YR 5/3) coarse sandy loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many fine and very fine roots; many fine tubular pores; neutral (pH 7.2); clear smooth boundary.

C-15 to 22 inches; light brownish gray (10YR 6/2) coarse sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few fine and very fine roots; few fine tubular pores; neutral (pH 7.0); gradual wavy boundary.

Cr-22 to 24 inches; disintegrating, fractured granitic bedrock; few roots in principal cracks.

R-24 inches; bedrock.

The solum is 12 to 21 inches thick. The mollic epipedon is 10 to 15 inches thick. Coarse fragments make up 10 to 20 percent of the solum. Reaction is slightly acid to neutral. Bedrock is at a depth of 20 to 40 inches. The base saturation is 50 to 75 percent in the upper 75 centimeters.

The A horizon has value of 4 or 5, dry, and 2 or 3, moist, and chroma of 1 or 2.

The B2 horizon has value of 4 or 5, dry, and 2 or 3, moist, and chroma of 2 or 3. It is coarse sandy loam or sandy loam or the fine gravelly analogs.

The C horizon has value of 5 or 6, dry, and 3 or 4, moist, and chroma of 2 or 3. It is coarse sandy loam or sandy loam or the fine gravelly stony analogs.

Simonton series

The Simonton series consists of very deep, well drained soils that formed in alluvium that derived from acid igneous rocks. Simonton soils are on alluvial fans and terraces and have slopes of 0 to 25 percent. The average annual precipitation is 14 inches, and the average annual temperature is 41 degrees F.

Simonton soils are similar to Elkcreek soils. They are near Brinegar, Rands, Riceton, and Vodermaier soils. Unlike Simonton soils, Elkcreek soils are 20 to 40 inches deep to bedrock. Brinegar soils are moderately well drained and have a mollic epipedon thicker than 20 inches. Rands soils have a clayey argillic horizon. Riceton soils have a coarse-loamy control section. Vodermaier soils have a sandy control section.

Typical profile of Simonton loam, 0 to 4 percent slopes, about 1 mile south and 1.5 miles east of Fairfield; 130 feet west and 250 feet south of the NE corner of sec. 23, T. 1 S., R. 14 E.

Ap-0 to 7 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many fine interstitial pores; medium acid (pH 5.6); abrupt smooth boundary.

B1-7 to 10 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and slightly plastic; common fine roots; many fine tubular pores; medium acid (pH 6.0); clear smooth boundary.

B21t-10 to 15 inches; pinkish gray (7.5YR 6/2) loam, brown (7.5YR 4/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common fine roots; many fine tubular pores; few thin clay films on vertical faces of peds and lining pores; medium acid (pH 6.0); clear smooth boundary.

B22t-15 to 21 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; weak medium prismatic structure that parts to moderate medium subangular blocky; hard, firm, sticky and plastic; common fine roots; many fine tubular pores; many thin clay films on faces of peds and lining pores; slightly acid (pH 6.4); gradual smooth boundary.

B23t-21 to 37 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common fine roots; common fine tubular pores; many thin clay films on faces of peds and lining pores; neutral (pH 6.7); gradual wavy boundary.

C-37 to 60 inches; light gray (10YR 7/2) loamy ,sand, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; few fine roots; common fine tubular pores; neutral (pH 6.8).

The solum is 30 to 40 inches thick. The mollic epipedon is 10 to 16 inches thick. Reaction ranges from medium acid to neutral. The base saturation is 50 to 75 percent in some part above a depth of 75 centimeters.

The A horizon has value of 4 or 5, dry, and chroma of 2 or 3, moist and dry.

The B horizon has hue of 5YR through 10YR; value of 4 through 6, dry, and 3 or 4, moist; and chroma of 3 or 4, moist and dry. It is loam, sandy clay loam, or clay loam.

Strom series

The Strom series consists of very deep, somewhat poorly drained soils that formed in mixed alluvium. Strom soils are on alluvial fans, low terraces, and bottom lands and have slopes of 0 to 4 percent. The average annual precipitation is 14 inches, and the average annual temperature is 41 degrees F.

Strom soils are similar to Houk soils. They are near Brinegar and Marshdale soils. Unlike Strom soils, Brinegar soils are moderately well drained. Marshdale soils are poorly drained and do not have an argillic horizon. Houk soils are more than 35 percent clay in the control section.

Typical profile of Strom loam, 0 to 4 percent slopes, about 4 miles west and 1 mile south of Fairfield; 335 feet east and 715 feet north of the SW corner of sec. 13, T. 1 S., R. 13 E.

Ap1-0 to 6 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to moderate fine granular; hard, firm, sticky and plastic; common very fine and fine roots; many very fine interstitial pores; slightly acid (pH 6.4); clear smooth boundary.

Ap2-6 to 11 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate medium and coarse subangular blocky structure; hard, very firm, sticky and plastic; common very fine and fine roots; common fine tubular pores; neutral (pH 6.8); clear smooth boundary.

A2-11 to 14 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; few fine tubular pores; neutral (pH 7.0); abrupt discontinuous boundary.

B21t-14 to 25 inches; dark gray (10YR 4/1) clay loam, black (10YR 2/1) moist; strong medium prismatic structure that parts to strong fine and medium subangular blocky; very hard, firm, sticky and plastic; common very fine and fine roots; few fine tubular pores; many thin clay films on faces of peds and lining pores; neutral (pH 7.2); gradual smooth boundary.

B22t-25 to 33 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; strong medium and coarse prismatic structure that parts to strong fine and medium angular blocky; very hard, firm, sticky and plastic; common very fine and fine roots; few fine tubular pores; many thin clay films on faces of peds and lining pores; mildly alkaline (pH 7.8); clear smooth boundary.

B3ca-33 to 41 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; moderate medium and coarse prismatic structure that parts to moderate medium and coarse subangular blocky; very hard, firm, slightly sticky and slightly plastic; common very fine and fine roots; common fine and medium tubular pores; slightly calcareous, lime segregated in fine filaments; moderately alkaline (pH 8.2); clear smooth boundary.

C1g-41 to 51 inches; light gray (10YR 7/1) sandy loam, gray (10YR 6/1) moist; common fine prominent mot-

ties of yellowish brown (10YR 5/6) and brownish yellow (10YR 6/8) moist; massive; slightly hard, friable; few very fine roots; few fine and medium tubular pores; mildly alkaline (pH 7.4); abrupt smooth boundary.

C2g-51 to 62 inches; light gray (10YR 7/1) sandy loam, gray (10YR 6/1) moist; many medium and coarse prominent mottles that are yellowish brown (10YR 5/6) and brownish yellow (10YR 6/8) moist; massive; slightly hard, friable; slightly sticky and slightly plastic; few fine tubular pores; mildly alkaline (pH 7.4).

The solum is 32 to 44 inches thick. The mollic epipedon is 24 to 36 inches thick and includes a part of the argillic horizon. Coarse fragments make up less than 10 percent of the solum. The water table is at a depth of 24 inches in spring, but it is below a depth of 50 inches late in summer and in fall. Mottles are at a depth of 30 to 45 inches. Reaction ranges from slightly acid to moderately alkaline.

The A horizon has hue of 10YR to neutral; value of 3 through 5, dry, and 2 or 3, moist; and chroma of 0 or 1.

The B2t horizon has hue of 10YR to neutral; value of 4 or 5, dry, and 2 to 3, moist; and, chroma of 0 through 2. It is clay loam and loam and is 25 to 35 percent clay.

The C horizon is stratified sandy clay loam, sandy loam, loamy sand, or sand.

Vodermaier series

The Vodermaier series consists of very deep, somewhat excessively drained soils that formed in mixed alluvium that derived from acidic and basic igneous rocks. Vodermaier soils are on alluvial fans and terraces and have slopes of 0 to 12 percent. The average annual precipitation is 14 inches, and the average annual temperature is 41 degrees F.

Vodermaier soils are similar to Riceton soils. They are near Brinegar and Little Wood soils. Unlike Vodermaier soils, Riceton soils are in the coarse-loamy family. Brinegar soils are fine-loamy and are moderately well drained. Little Wood soils are loamy-skeletal and they have an argillic horizon.

Typical profile of Vodermaier gravelly coarse sandy loam, 0 to 4 percent slopes, about 2 miles south and 1.5 miles west of Fairfield; 100 feet east and 425 feet south of the north quarter corner of sec. 29, T. 1 S., R. 14 E.

Ap-0 to 7 inches; grayish brown (10YR 5/2) gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable; many very fine and fine, common medium, and few coarse roots; many fine interstitial pores; 30 percent gravel; slightly acid (pH 6.3); clear smooth boundary.

A12-7 to 22 inches; dark grayish brown (10YR 4/2) gravelly loamy coarse sand, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; soft, very friable; common fine and medium and few coarse roots; many fine tubular pores; 30 percent gravel; medium acid (pH 5.6); gradual wavy boundary.

A13-22 to 30 inches; dark grayish brown (10YR 4/2) gravelly loamy coarse sand, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; soft, very friable; common fine and medium and few coarse roots; many fine tubular pores; 30 percent gravel; medium acid (pH 5.8); gradual wavy boundary.

C1-30 to 43 inches; grayish brown (10YR 5/2) gravelly loamy coarse sand, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable; common fine and medium and few coarse roots; many fine tubular pores; 30 percent gravel; many krotovinas, 5 to 13 millimeters in diameter, that are light yellowish brown, (10YR 6/4) dark yellowish brown (10YR 4/4) moist; medium acid (pH 5.9); gradual irregular boundary.

C2-43 to 60 inches; light yellowish brown (10YR 6/4) very gravelly coarse sand, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable; common fine and medium roots; many fine tubular pores; slightly acid (pH 6.2).

The solum is 25 to 36 inches thick, and it is 20 to 35 percent coarse fragments. The base saturation is 50 to 75 percent in some part above a depth of 75 centimeters. Reaction ranges from medium acid to neutral.

The A horizon has value of 4 or 5, dry, and 2 or 3, moist, and chroma of 2 or 3, dry and moist.

The C1 horizon has hue of 10YR or 7.5YR; value of 4 or 5, dry, and 2 or 3, moist; and chroma of 2 or 3. The C2 horizon has hue of 10YR or 7.5YR; value of 5 through 7, dry, and 4 or 5, moist; and chroma of 2 through 4, moist and dry. It is very gravelly loamy coarse sand or very gravelly coarse sand.

Winu series

The Winu series consists of moderately deep, well drained soils that formed in material that weathered from basalt or rhyolite. Winu soils are on mountains and have slopes of 20 to 60 percent. The average annual precipitation is 16 inches, and the average annual temperature is 40 degrees F.

Winu soils are similar to Earcree and Lockman soils, and they are near Elkcreek and Gaib soils. Unlike Winu soils, Earcree and Lockman soils are coarse-loamy. Elkcreek soils have a summer soil temperature of more than 60 degrees F. Gaib soils have bedrock at a depth of less than 20 inches.

Typical profile of Winu stony loam in an area of WinuGaib complex, 30 to 60 percent slopes, about 7 miles south and 2.25 miles west of Corral; in the NW1/4SW1/4 sec. 14, T. 2 S., R. 12 E.

A11-0 to 2 inches; dark gray (10YR 4/1) stony loam, black (10YR 2/1) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine interstitial pores; medium acid (pH 5.6); clear smooth boundary.

A12-2 to 17 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure that parts to weak very fine granular; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; medium acid (pH 5.6); clear smooth boundary.

B1t-17 to 22 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; few thin clay films on faces of peds; medium acid (pH 5.6); clear smooth boundary.

B2t-22 to 26 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular pores; few thin clay films on faces of peds and lining pores; medium acid (pH 5.6); clear irregular boundary.

B3-26 to 31 inches; yellowish brown (10YR 5/4) very gravelly loam; dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; medium acid (pH 5.6); gradual irregular boundary.

C-31 to 34 inches; yellowish brown (10YR 5/4) very gravelly loam; dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; medium acid (pH 5.5); abrupt wavy boundary.

R-34 inches; bedrock.

The solum is 19 to 33 inches thick. The mollic epipedon is 19 to 27 inches thick. Reaction is strongly acid to medium acid. Bedrock is at a depth of 24 to 40 inches. The control section is 15 to 35 percent, by volume, coarse fragments.

The A horizon has hue of 10YR or 7.5YR; value of 3 through 5, dry, and 2 or 3, moist; and chroma of 1 to 3.

The B2t horizon has hue of 7.5YR or 10YR; value of 5, dry, and 3 or 4, moist; and chroma of 3 or 4, moist and dry.

Yutrue series

The Yutrue series consists of deep and very deep, well drained soils that formed in material that weathered from basalt. Yutrue soils are on lava plains and have slopes of 0 to 20 percent. The average annual precipitation is 14 inches, and the average annual temperature is 47 degrees F.

The Yutrue soils are similar to the Magic soils and are near Bostrum soils. Unlike Yutrue soils, Bostrum soils are 20 to 40 inches deep to bedrock and have a fine-textured argillic horizon. Magic soils are 25 to 40 inches deep to bedrock.

Typical profile of Yutrue stony clay, 0 to 12 percent slopes, about 2.5 miles southwest of Magic Reservoir Dam; 1,701 feet west and 2,180 feet south of the NE corner of sec. 26, T. 2 S., R. 17 E.

A11-0 to 2 inches; light brownish gray (10YR 6/2) stony clay, dark grayish brown (10YR 4/2) moist; weak thin platy structure that parts to moderate very fine granular; hard, friable, very sticky and very plastic; common very fine, fine, and medium roots; many very fine interstitial pores; neutral (pH 6.9); clear smooth boundary.

A12-2 to 15 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure that parts to moderate medium and coarse angular blocky; very hard, very firm, very sticky and very plastic; few very fine, fine, and medium roots; common fine tubular pores; neutral (pH 7.0); clear smooth boundary.

A13-15 to 26 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; moderate coarse prismatic structure that parts to moderate medium angular blocky; very hard, very firm, very sticky and very plastic; few fine and medium roots; few very fine tubular pores; neutral (pH 7.2); clear wavy boundary.

B21-26 to 35 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak thin platy structure that parts to moderate medium angular blocky; hard, friable, sticky and plastic; few very fine and fine roots; many very fine tubular pores; few thin clay films on faces of peds and lining pores; few fine white (N 8/0) rounded soft salt masses; mildly alkaline (pH 7.4); clear wavy boundary.

B22-35 to 42 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; moderate fine and medium angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine tubular pores; common moderately thick grayish brown (10YR 5/2), dry, and very dark grayish brown (10YR 3/2), moist, clay films on faces of peds and lining pores; mildly alkaline (pH 7.6); clear wavy boundary.

B23ca-42 to 63 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; moderate fine prismatic structure that parts to moderate fine and medium angular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine tubular pores; many thick light brownish gray (10YR 6/2), dry, and dark grayish

brown (10YR 4/2), moist, clay films on faces of peds and lining pores; violently effervescent, lime segregated in common medium irregular seams; mildly alkaline (pH 7.6); clear wavy boundary.

B24ca-63 to 68 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3), brown (10YR 5/3) rubbed moist; moderate fine prismatic structure that parts to moderate fine and medium angular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine tubular pores; common thick clay films on faces of peds and lining pores; violently effervescent, lime segregated in common medium irregular seams; mildly alkaline (pH 7.8).

Pebbles, cobblestones, and stones cover 5 to 30 percent of the surface. The solum is 40 to 68 inches thick. Bedrock is at a depth of 40 to 60 or more inches.

The Al horizon is silty clay or clay that may be gravelly, cobbly or stony. The A horizon has hue of 10YR or 7.5YR; value of 5 through 7, dry, and 3 through 5, moist; and chroma of 2 or 3, dry and moist.

The B horizon has hue of 7.5YR or 10YR; value of 5 or 6, dry, and 3 through 5, moist; and chroma of 2 through 4 moist and dry. It is silt loam, clay loam, silty clay loam, silty clay, or clay.

Formation of the soils

Soil is a natural body on the surface of the earth in which plants grow. The characteristics of a soil are determined by the interaction of parent material, climate, relief, living organisms, and time (4).

Parent material

The soils in the Camas County Area formed in residual, alluvial, and eolian parent material.

The alluvial parent material is generally of local origin. It washed from a wide variety of granitic, basaltic, rhyolitic, and andesitic rock formations in the uplands. Brinegar, Houk, Marshdale, and Strom soils formed in this material.

Snake River basalt is the youngest igneous rock in the survey area. The basalt is dark and was deposited as flows, mainly in the southwestern part of the survey area. It is as much as 700 or more feet thick and commonly has a rough or rubbly surface. Most of it has weathered very little. Harahill, Laurentzen, Magic, and Manard soils formed in material that derived from this basalt.

Volcanic and sedimentary rocks underlie the Snake River basalt or are exposed. These rocks formed during the Miocene and Pliocene epochs. The volcanics are more acidic and are lighter in color than the basalt. Thick flows and blankets of welded tuff and beds of ash and pumice are associated with the lava flows. Deformation of the earth's crust has produced some faulting and folding of these beds. Elkcreek, Gaib, Rands, Simonton, and Winu soils formed in material that weathered from these rocks.

A major volcanic formation is in the mountainous area in the east-central part of the survey area. The rocks formed in the period from early Tertiary to early Miocene, and they are more than one mile thick. They range from rhyolite to basalt in composition but are mainly intermediate in composition. Water-lain clastics, largely tuffaceous, are common; they generally occur as rugged, steeply sloping outcrops. Elkcreek, Earcree, and Gaib soils formed in material that weathered from these rocks.

The rugged mountainous areas in the northern and northwestern parts of the survey area are part of the Idaho Batholith. Quartz monzonite, granodiorite, quartz diorite, and granite are in this formation. Bauscher, Earcree, Lockman, and Roanhide soils formed in material that weathered from these rocks.

Eolian material is of minor importance as parent material in the survey area. Only the Kevanton soils show evidence of major influence by eolian material. The eolian sands in which these soils formed are most likely of local origin-from the bottom lands that lie to the west.

Climate

Climate functions directly in the formation of soil because it affects the parent material and the differentiation of horizons. Temperature and precipitation govern the rate of weathering of minerals and organic matter. They also influence leaching, eluviation and illuviation, and growth of vegetation.

The climate in the survey area can be generally classified as humid continental, cool summer, which is characterized by moist, cold winters and dry summers.

Local differences in annual precipitation and temperature are determined by relief. The greatest amount of precipitation is in the higher mountains in the northern and northeastern parts of the survey area, where the annual average is 18 inches. The average annual precipitation in the Fairfield area is 14 inches, but near Magic Reservoir it is 11 to 12 inches. The warmest temperatures are in the western part of the survey area, where the average annual temperature is 47 degrees F. The coldest temperatures are in the higher mountains in the northern part of the survey area, where the average annual temperature is 38 to 43 degrees F.

In the southwestern part of the survey area, the climate is conducive to the growth of grasses, which dominate the native vegetation on the loess-covered plains. As a result, the soils are higher in content of organic matter than other soils in the survey area. Harahill and Laurentzen soils are examples. They have less than 75 percent base saturation because of leaching.

Relief

Relief influences the formation of soils through its effects on water drainage, erosion, air drainage, and variation in exposure to sun and wind.

The southern part of the survey area is in the Columbia Plateau Province, and the northern part is in the Rocky Mountain Province. The northern edge of the survey area is steep and mountainous with narrow, alluvial valleys. Just south of this mountainous area lies a broad alluvial valley, which is mostly cultivated.

The mountains are dissected by deep drainageways. The process of dissection formed long, winding ridges that have steep and very steep side slopes. Because of the slope gradient most of the soils are well drained or somewhat excessively drained. Most of these soils are only moderately deep because of geologic erosion and accelerated erosion. Elkcreek, Roanhide, and Winu soils are examples.

Relief has a pronounced effect on climate. For example, the amount of annual precipitation ranges from 12 inches at Magic Reservoir to more than 25 inches in the mountains near Cannonball. Earcree and Winu soils, at the higher elevations on the north-facing side slopes, receive less direct sunlight, have colder soil temperatures, and retain moisture longer than other soils. Elkcreek, Roanhide, and Winu soils, on south-facing side slopes, receive more sunlight, have warmer soil temperatures, and dry out faster. These differences determine the kind of vegetation that grows on the soil and consequently the content of organic matter in the soil. Generally, there is more leaching of exchangeable bases in the soils that retain moisture longer.

The flood plain of Camas Creek and its tributaries slopes less than 4 percent. As a result, drainage is poor and the water table is high or fluctuating. Marshdale, Strom, and Houk soils formed under water-tolerant plants on the flood plain. Because these soils are poorly drained and somewhat poorly drained there are reddish, yellowish, and bluish mottles in the lower horizons evidence of intense reduction of iron. The moderately well drained Brinegar soils and the well drained Riceton and Simonton soils formed on terraces above the flood plain.

Living organisms

Plants and animals add organic matter to the soil. The accumulation of this organic matter is an important characteristic differentiating soil horizons.

The soils on the loess-covered plains in the western part of the survey area formed under grasses. The fibrous roots add humus to the soil, and the content of organic matter in the soil may be as high as 5 percent. Micro-organisms are very active in these soils. The abundant humus influences the color, structure, and physical condition of the Harahill and Laurentzen soils.

The poorly drained and somewhat poorly drained soils on the flood plains formed under water-loving grasses, sedges, and rushes. Consequently, these soils are the darkest in the survey area. In most of these soils, the content of organic matter is more than 2 percent. These soils provide good habitat for micro-organisms. Marshdale, Houk, and Strom soils are examples.

The soils that formed under low sagebrush or alkali sagebrush have a clayey subsoil or are very shallow to bedrock. Bostrum, Gaib, Manard, Polecreek, and Rands soils are examples.

.The soils that formed under big sagebrush and bunchgrass do not have a heavy subsoil. Simonton, Bauscher, and Riceton soils are examples. Lockman soils formed under Douglas-fir and big sagebrush.

Time

The formation of a soil is a continuous process that can be studied as a series of stages. Each stage results in the formation of a soil horizon.

In general, soils on the flood plains are young. Marshdale soils, for example, developed in unstable areas, where soil material is being deposited or eroded away. These soils have been influenced enough by soil-forming processes to have an A horizon and some leaching of bases.

Bostrum, Manard, Polecreek, Rands, and Yutrue soils are on old dissected plains. These are the oldest and most strongly developed soils in the survey area. Evidence of this development is the abrupt change in texture from the A horizon to the B2t horizon, which indicates the translocation of silicate clay minerals.

Soils on the mountains and foothills differ somewhat in degree of development. Young soils, such as those in the Roanhide series, have steep slopes, are moderately deep to bedrock, and contain no evidence of the translocation of silicate clay minerals. Earcree soils also are young, but they are less susceptible to erosion than Roanhide soils; therefore, they have more organic matter in the surface layer than the Roanhide soils and they show evidence of some chemical alteration of primary minerals. Bauscher, Elkcreek, Gaib, and Simonton soils are intermediate in age. They show evidence of some translocation of silicate clay minerals. This is indicated by the variations in color, texture, structure, and consistence in the B2t horizon.

References

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. In 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Camas County Planning Commission. 1976. Camas County comprehensive plan. 38 pp., illus.

(4) Jenny, Hans. 1941. Factors of soil formation. McGraw-Hill Book Company, Inc., 281 pp., illus.
(5) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]
(6) United States Department of Agriculture. 1961. Land capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.
(7) United States Department of Agriculture. 1971. Idaho soil and water conservation needs inventory, 1967. Soil Conserv. Serv. 187 pp.
(8) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Base saturation. The degree to which material having cation changeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are

Loose.-Noncoherent when dry or moist; does not hold together in a mass.

Friable.-When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.-When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.-When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.-When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.-When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.-When dry, breaks into powder or individual grains under very slight pressure.

Cemented.-Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Culmination of the mean annual increment. The age or rotation at which growing stock of a forest produces the greatest annual growth (for that time period). It is the age at which periodic annual growth and mean annual growth are equal.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Depth to rock. Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.-Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.-Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.-Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained-Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained. -Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained-Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.-Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly con-

tinuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.-An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.-The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B. horizon.-The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.-The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II *precedes the letter C.*

R layer.-Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are

Border-Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.-Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.-Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation. -Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.-Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.-Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.-Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.-Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous areas. Areas that have little or no natural soil and support little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence,

color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance-few, *common,* and *many, size-fine, medium,* and *coarse;* and con*trast-faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables-hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 1 OYR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, differences in slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slicken sides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer

than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular.* *Structureless soils* are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying sur face layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the low lands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.